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CONTENTS.

"Operating Electrical Men"—Illustrated Supplement.....369-374
EDITORIAL:
The Electrical Nature of Matter and Radioactivity..... 375
Engineering Education for Everybody..... 376
Substation Fire Hazards..... 376
Our Illustrated Supplement..... 377
Subway Cars..... 377
The Candle-Power of Lighthouses..... 377
The Electric Motor in Railway Work..... 377
The Electrical Nature of Matter and Radioactivity, by Harry C. Jones..... 378
The Accelerometer..... 380
Electric Elevators—II, by E. R. Carichoff..... 380
Report of the Royal Commission on London Traffic..... 382
The Submarine Cable to Iceland..... 382
The Banquet of the Old Time Telegraphers..... 383
Production of Radium from Uranium..... 383
American Electrochemical Society..... 383
Executive and Operating Staff of the Western Union Telegraph Company..... 384
Essential Features of Public Telegraph Service, by J. C. Barclay..... 385
A Well-Telephoned Territory, by John C. Reilly..... 385
Proper Methods of Conducting Painting Tests, by Gustave W. Thompson..... 386
Association of Edison Illuminating Companies..... 389
Water Power in Switzerland..... 389
Tramway for Removing Garbage..... 389
Telephone Progress in New York City..... 390
The Mariner's Yarn..... 390
The Frome, England, Electricity Works..... 390
The New Station of the Hartford Electric Light Company..... 391
Power at Niagara Rapids..... 397
The Residual Electromotive Force of the Carbon Arc..... 398
Line Troubles..... 398
Line Construction, by B. L. Chase..... 399
The Development of the Postal Telegraph Cable Company, by Charles P. Bruch. 400
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE..... 402
INDUSTRIAL SECTION:
A New Type of Arc Lamp..... 404
A Large Static Transformer..... 406
The "Automotoneer"..... 407
New Style Skeleton Frame Induction Motor..... 408
General Electric Circuit-Breakers..... 409
A Heavy Cable Reel Winding Gear..... 410
New "Connecticut" Volt-Ammeter..... 410
"I-T-E" Circuit-Breakers..... 410
Series Alternating-Current System of Arc Lighting..... 412
Superheated Steam..... 413
Some Recent Bullock Electrical Machinery..... 415
CURRENT ELECTRICAL NEWS..... 417

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY.

Probably no development in science—certainly, none that has occurred in recent years—has attracted so much attention, not only from the scientifically inclined, but as well from the public at large, as that which may be briefly summarized under the caption "radioactivity." This term, which carries such significance to-day, was unheard ten years ago. The phenomena which it designates were unknown at that time. We were familiar with Crookes's beautiful experiments, and Rœntgen's wonderful rays were still new. But neither of these so caught the public fancy, or so carried away the scientific world, as did Becquerel's far-reaching discovery. Rœntgen's work, it is true, attracted much attention for a time, not only on account of its novelty, but because of its probable value in surgery. He, as well as Crookes, did much to prepare us, mentally and scientifically, for the later discoveries. They laid two great stepping-stones in the path of scientific advance, but it has remained for the new phenomena of radioactivity to embrace the greatest arc in the scientific horizon of any recent development in science.

Every one to-day, no matter how far away from scientific applications his daily work may lie, feels, to some extent, interested in great scientific discoveries, for there are few who do not realize, in some degree at least, what science has done and is doing for the good of the world. It is therefore to be expected that when the scientific world feels that some of its most venerated ideas are attacked and certain of its most firmly established theories questioned that each and all should be interested. Becquerel's observation has led to the discovery of facts and new theories which are of the greatest importance, and the future alone will show whether those who have given rein to their imagination in seeking the truth have overrun the mark, and whether the new phenomena will make necessary the discarding of older theories. But whatever the outcome may be, all feel assured that it will establish firmer and broader foundations for all branches of science. Many hope it will reveal, in part at least, the general plan to which all may be coordinated.

While there have been a number of excellent books published on the interesting and important subject of radioactivity, these have been written more particularly for the scientifically trained. It is therefore with great pleasure that we begin with this issue of the ELECTRICAL REVIEW a series of papers entitled "The Electrical Nature of Matter and Radioactivity," by Dr. Harry C. Jones, professor of physical chemistry at Johns Hopkins University. Doctor Jones is widely known from his writings on electrochemical subjects, and he has made a long and special study of the new developments in physical science. His articles, while thoroughly scientific, will be written so that all may read and understand. Abstruse mathematical explanations will not be used, since Doctor Jones has the faculty of interpreting into plain English the most difficult mathematical arguments. We believe that these articles will be thoroughly appreciated, as well for the manner in which they are presented as for the subject with which they deal. A not unimportant feature of them will be bringing the subject up to date, which is essential in dealing with one which has advanced so rapidly.

ENGINEERING EDUCATION FOR EVERYBODY.

For some time past the engineer has borne the stigma of a narrowly educated man. The endeavor has been to instill into the student as much practical knowledge as he could hold. Studies not having immediate application to his chosen work were held to be secondary in importance, and while not entirely neglected, but little time was devoted to them. This was some time ago, at which time there had been a strong appeal to the technical school to supply men with very specialized training. This appeal was heeded, but it was soon seen that there was danger of over-specialization, not only to the students themselves, but to the institutions, which were much overburdened by the increased work required for specialized courses; and the instructors of the technical schools were among the first to sound a note of warning. The pendulum has now swung again, and the tendency to-day is to give a thorough course in the principles of engineering, with as much time devoted to the application of these principles and to other subjects as can be spared. These other courses include the so-called culture studies, a designation which the technical student hears with suspicion, since it implies that there is no cultural value in his own chosen course. But the pendulum has not stopped at the centre of its swing; is now rising on the other side. Not only does the technical student give considerable time to non-technical studies, but it is urged by some that it would be an excellent thing if students of all non-technical courses could be given some general instruction in engineering work. This proposal is put forward by Professor Charles D. Marx, in an article on "General Education for Engineers" appearing in the *Popular Science Monthly* for September. Professor Marx's idea is that, since the development of a country's resources and its everyday work must be done by the engineer, the large body of citizens should have some idea of how this is done. The problems of manufacture, distribution and transportation stand for the providing of material and mental food for the masses, the betterment of their conditions of living, for healthy homes, pure air, the pure earth, pure water of the sanitarian, for the intellectual growth which is made possible by freeing men from soul and mind-killing drudgery. Public service is what engineering stands for. "Surely," says Professor Marx, "he can not be held to be truly educated who is ignorant of the conditions which surround him, of the methods by which his daily intellectual and physical needs are met."

However desirable Professor Marx's plan may be, we still seem to be a long distance from it. The old tradition that any study having a practical value was not suitable for training the mind is still held so strongly in many quarters that years will be required before it will be overcome. Fortunately, the layman seems to have acquired a growing interest in engineering works, and by reading the papers he does, in a way, educate himself. He may not be able to grasp the points in an argument over the relative values of alternating and direct currents for railway work, for example, but he has reached a point where he realizes that the question is an exceedingly important one, and he acquires a respect for the men who grapple with it and decide it.

There is one phase of the training of the engineer which might well be impressed upon the general student—that is to say, the vital importance of correct reasoning; of building upon facts, and not upon ideas, and the disastrous results which must follow when the work is wrong.

SUBSTATION FIRE HAZARDS.

Many improvements have been effected in substation design of late years, but the proper treatment of fire hazards is still too often neglected. Efforts have been directed toward the improvements of both high and low-tension wiring, toward the simplifying of transformer, rotary converter and switchboard arrangement, and also toward the production of greater safety to the operating force. Fireproof construction is a notable feature of many modern substation buildings, especially in cities, but in frequent cases there seems to be little appreciation of the hazard involved in high-potential work, and one finds expensive equipment housed in structures so cheaply built that the extinguishing of even a small fire is a hard task. When one realizes that a substation containing but a single 250-kilowatt rotary converter may easily cost $10,000, the folly of refusing or neglecting to spend $10 or $15 for extinguishers, asbestos blankets, sand-pails, etc., is at once apparent. Quite apart from the loss of the equipment itself stands the reduction in earnings enforced by the absence of adequate power.

It is a simple matter to provide reasonable protection for the average substation. The use of wooden buildings is common in rural districts, but it would seem to be far better practice to employ brick or concrete in all high-tension installations. Even a 2,300-volt circuit carries the possibilities of danger on account of fire, and when one passes the 10,000-volt limit the installation of the equipment in anything but a fireproof building is a constant invitation to disaster. The wiring may be excellent, but lightning and overloads remain to be reckoned with. Fortunately designers of modern high-powered substations are coming to appreciate the situation, so that the problem for the most part is that of protecting existing installations.

The external hazard is serious in thickly populated districts, and in such cases the use of fireproof shutters or wired glass in the windows is often most essential. Elaborate facilities in the way of water supply for fire protection are out of place in electric plants containing merely transforming or distributing apparatus, but by the judicious adoption of chemical and sand-pail extinguishers, coupled with woolen blankets, both urban and rural substations can be protected at slight expense. Metal waste-cans and care in the storage of oil and supplies are the essentials of additional precaution. The point is simply that many companies do not seem to realize the existence of any fire hazard whatever in their remoter substations, and that now is the time to take the simple measures of precaution which a little common-sense thought will suggest as suitable in each individual case.

OUR ILLUSTRATED SUPPLEMENT.

The ELECTRICAL REVIEW presents in this issue an illustrated supplement giving portraits of twenty-seven of the leading operating electrical men of this country—men who have done much toward extending the application of electrical methods and upbuilding the electrical industry. These men are all widely known for their excellent work. They come from all parts of the country, and represent all branches of applied electricity. Great pains have been taken in preparing this supplement, and many of the photographs were especially taken for it. It gives an excellent idea of the high character of the men upon whom rests much of the responsibility for the success of the companies which they represent. We doubt if any other group of industries could make a more favorable showing of fine-looking and capable men.

SUBWAY CARS.

The blowing of a fuse recently on one of the trains of the New York subway should have the effect of giving the public greater confidence in the safety of the subway system. Through some unexplained defect, the arc was not extinguished when the fuse melted, but set fire to the insulation of the electrical conductors. This, of course, gave rise to considerable smoke, and for a time alarmed the passengers on the train. The alarm was further increased by the electrical display which occurred when one of the station men attempted to extinguish the fire by throwing water over it. The car was not damaged, and at no time were the passengers in danger, as they probably realize now. In fact, the floor of the car is so protected by fire-resisting material as to make it practically impossible for an arc between conductors to set fire to the car. Moreover, the standard type of car of the subway is now practically fireproof itself. It would be just as well, however, if the many employés of the company were fully instructed in the proper methods to pursue to extinguish an electric arc. A bucket of sand is of more value than a barrel of water.

THE CANDLE-POWER OF LIGHTHOUSES.

It is reported that a new lighthouse has just been put into service in the harbor of Boston, which is equipped with the most powerful light on the New England coast. The light throws out a flash that can be seen for over fifteen miles. This much of the report is satisfactory, in that it conveys some definite impression to the reader, but the same can not be said of the further announcement that the light "has a brilliancy of 192,000 candle-power." If this figure refers to the light thrown out in the beam it is indefinite, because the rays of the beam are approximately parallel, and the intensity obtained by measurement would depend largely upon the way the measurement was made. On the other hand, if the figure refers to the light given by the source itself, without the interposition of the lenses, it is still indefinite. Any luminous source throws out light in many directions, and in rating the lamp this should be remembered. The statement of intensity should be given as an average value or as a measurement in a certain particular direction. Then if a lens or reflector be interposed into the path of the light, the effect which it has upon the character of the beam thrown out should be explained. The mere statement that a lighthouse lamp has a brilliancy of some 200,000 candle-power contains no useful information, if we except the fact that it reads well in a popular article.

THE ELECTRIC MOTOR IN RAILWAY WORK.

One of the most interesting questions which holds the attention to-day is the extent to which the electric motor will be employed in railway work, meaning in this use the hauling of trains; but it is to its application to another phase of railway work to which we wish to call attention. A French engineer, M. A. Collet, has developed an electric system for constructing and maintaining railroads which is thought to embody a considerable advance over the hand labor which has been standard throughout the world. M. Collet's system consists of a small, portable generating plant and a number of portable motors driving the tools. The generating plant is composed of a twenty-five-horse-power steam engine driving a generator. This is mounted on wheels, so that it can be drawn along the track to the point at which the work is to be conducted and then lifted conveniently to one side. The tools used in connection with this are a drilling machine for drilling holes in the ties for the wood screws which are to-day used in France for fastening down the rails; a second machine for driving the screws home; and two other machines which are employed for tamping the ballast about the ties. These tools are mounted on light trucks, and can be lifted easily out of the way to allow a train to pass. They draw their supply from a trolley wire stretched to one side of the track. It is said that the system works much more rapidly than a gang of laborers. Four men can set 200 screws in ten minutes—about one-seventh of the time required to do the work by hand. A tie can be tamped in one minute, four men being required at the tools and two to supply the ballast.

To increase the efficiency of the system, and to add to the safety of the road, the inventor, very properly, connects this road-gang by telephone to the lookouts on the track, or even to the nearest station—a use of the telephone which might frequently be made with excellent results.

This use of portable electric tools for outside work is one which might easily be extended in other industries. Portable electric tools, whether of small or large size, have worked wonders in the shop and in shipyards. Why should they not do equally as well in railway work or in other service where at present large gangs of men are required? The success of the electric system depends upon the ease with which the power to operate the tools can be transmitted, and upon the ease with which the tools themselves can be carried from point to point. The Collet system is to be given a trial on the Paris-Lyons Mediterranean Railway, where it will be used to maintain a section of the main line for several years, thus affording an opportunity for its work to be compared with that done in the old way.

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY.

BY HARRY C. JONES.

CHAPTER I.

THE ELECTRICAL CONDUCTIVITY OF GASES.

The power of gases, under normal conditions, to conduct electricity is so small that it has been doubted whether pure, dust-free gases can conduct at all. It has, however, long been known that electricity can leak through gases. This has been supposed by some to be due to dust in the gas, or to imperfect insulation in the supports for the charged body—the leak taking place along these supports. The recent refined experiments of Wilson, however, show that while pure, dust-free gases have only a small conductivity, they have a definite power to conduct electricity, which is measurable. He used a small gold-leaf electroscope, which has little capacity, in order to measure the small quantity of electricity which leaks off of the charged body, through the gas. As the result of elaborate investigations on the problem, Wilson concluded, as stated above, that pure gases have a very small, but determinable power to carry electricity.

CONDITIONS WHICH INCREASE THE CONDUCTIVITY OF GASES.

While gases under normal conditions have only slight conductivity, and are fairly good insulators, it is not a difficult matter to increase greatly the conductivity of gases. This can be done in a number of ways; when gases are heated to high temperatures their electrical conductivity is greatly increased. According to Becquerel, when air is heated to a white-heat electricity will pass through it when the difference in potential is only a few volts. It is also known that gases in contact with incandescent solids have their conductivity increased. Some interesting and important facts, which it would lead us too far at present to discuss, have been brought to light through the study of these phenomena.

Gases taken from flames have been found to have considerable conductivity, which is retained for some time after the gas has been removed from the flames and cooled down.

Another means of increasing the conductivity of a gas is by subjecting it to the action of ultra-violet light. A freshly cleaned plate of zinc charged with negative electricity, loses its charge when exposed to the action of ultra-violet light. This shows that ultra-violet light has produced some change in the air that surrounds the plate, which enables the electricity on the plate to escape. Other agents which increase the conductivity of gases are Rœntgen rays, the presence of radioactive substances, and cathode rays. As these will be taken up in detail in these papers, they will not be discussed further in the present connection.

HOW A CONDUCTING GAS DIFFERS FROM A NON-CONDUCTING.

We have seen that a gas in the normal condition has very small power to conduct electricity. Indeed, so small that it requires very sensitive apparatus to detect the flow of electricity through the gas.

We have also seen that the conducting power of a gas can be greatly increased by a number of widely different agents. The question that would naturally arise in this connection is, how does a conducting gas differ from a non-conducting or normal gas? (we may term a normal gas non-conducting, since its conductivity is so slight.)

To answer this question we must study the properties of a conducting gas, and compare them with the properties of a non-conducting gas.

If the conducting gas is made to pass through a plug of glass-wool, or is drawn through water, it loses its conducting power. The conducting power of a gas is also removed by passing the gas through a metal tube of fine bore; the finer the bore the more rapidly the conductivity is lost.

A conducting gas loses its conducting power when passed through a strong electric field, so as to be traversed by an electric current.

The removal of the conducting power by filtering through glass-wool shows that the conductivity of the gas is due to some constituent which is filtered out by the glass-wool. The experiments with the metal tube and with the electric field, show that this constituent which can be filtered out by glass-wool is charged with electricity. These charged particles in a conducting gas are known as *ions*. Some of these particles are charged positively and others negatively. Since a conducting gas shows neither an excess of positive nor negative electricity it is, as we say, electrically neutral.

THE RATIO OF THE CHARGE TO THE MASS OF THE IONS IN A GAS.

When an acid, base or salt is dissolved in water, we know that it breaks down into charged parts called ions. Every molecule of the electrolyte yields an equivalent number of positively charged parts or cations, and negatively charged parts or anions. The ratio between the charge carried by these ions and their mass has been determined. In the case of the hydrogen ion, which is the characteristic ion of all acids, it has been found to be of the order of magnitude 10^4.

It was recognized to be of importance to determine the ratio of the charge to the mass of the ions in gases. If we represent the charge carried by the gaseous ion by e, and the mass of the ion by m, the ratio in question is $\frac{e}{m}$.

We shall take up first the determination of the ratio $\frac{e}{m}$ for the cathode particle.

THE CATHODE RAY.

When an electric discharge is passed through a high-vacuum tube, rays are sent out from the cathode, which produce a greenish-yellow fluorescence where they fall upon the glass walls of the tube. These are known as the cathode rays. The nature of these rays was for some time in doubt. It was thought by some investigators, especially by Goldstein, that they are waves in the ether. It remained for Sir William Crookes to give us the accepted explanation of the nature of the cathode rays. According to Crookes the cathode rays are electrified particles, sent off from the cathode with high velocity, and in a direction at right angles to the surface of the cathode. The properties of the cathode rays, in general, are in accord with this theory. The cathode rays can be deflected by a magnet.

A solid body placed in their path casts a well-defined shadow.

Cathode rays can probably produce certain chemical changes, especially of a reducing nature.

Mechanical effects can readily be produced by the cathode rays, as was shown by Sir William Crookes. A glass wheel is easily made to move along level glass tracks within the tube, by allowing the cathode rays to impinge upon the vanes.

Thermal effects are readily produced by the cathode rays. By suitably concentrating them upon platinum, the metal is rendered incandescent. All of these facts accord with the theory as to the nature of the cathode rays, advanced by Sir William Crookes.

The discovery that cathode rays can pass through thin films of metal seemed at first to argue against the Crookes theory. When we become familiar later with the nature of the cathode particle itself, we shall see that this argument is without foundation.

We shall, then, at present accept the

Crookes theory and regard the cathode rays as made up of negative electrified particles, moving with high velocities in straight lines at right angles to the surface of the cathode.

In the light of the above theory and the facts upon which it is based, we shall now take up the work of J. J. Thomson, by which he determined the value of $\frac{e}{m}$ for the cathode particle.

THE VALUE OF $\frac{e}{m}$ FOR THE CATHODE PARTICLE.

The value of $\frac{e}{m}$ for the cathode particle was determined by J. J. Thomson, as follows: The cathode is placed at one end of the exhausted tube, and the anode removed only a short distance from the cathode. Beyond the anode on the side removed from the cathode is placed a thick metal disc connected with the earth. A small hole is bored through the centre of the anode and the metal disc. Cathode rays pass through these holes and fall on the wall of the vacuum tube at the end of the tube farthest removed from the cathode. Since the holes in the metal plates are small, we have a small beam of cathode rays striking the inner wall of the glass vessel, forming a small phosphorescent spot on the glass.

We have seen that the cathode rays are deviated by a magnetic field. If the whole tube is now so placed in a magnetic field that the path of the ions is at right angles to the lines of force, the path of the cathode particles will be changed, and they will impinge upon the glass wall at some point different from that which they originally bombarded when no magnetic field was present. Knowing the magnitude of this deflection we can calculate the value of $\frac{e}{vm}$, in which v is the velocity of the ion.

We have thus determined the ratio of e to vm and consequently of $\frac{e}{m}$ to v.

We must now determine the value of v in order to obtain the ratio $\frac{e}{m}$.

Into the above-mentioned vacuum tube are inserted two parallel metal plates, between which the beam of cathode particles passes. The plates are also parallel to the original, undeflected beam. These metal plates are attached to some electrical source, and maintained at a known difference in potential. We thus have between the plates an electric field, whose lines of force are at right angles to the path in which the ions in the cathode stream are moving. This electrostatic force s, deflects the ion with a force se, e being the charge upon the ion. The force due to the magnetic field already considered is mev, m being the strength of the field, e the charge carried by the ion, and v the velocity of the ion.

By suitably charging the metal plates positively and negatively, the electrical and magnetic forces can be made to act counter to one another. By keeping one of these constant and varying the intensity of the other, these two counter forces can readily be made equal to each other. This can easily be determined. We note the original position of the phosphorescent spot on the glass before placing the apparatus in the magnetic field. When the apparatus is placed in the magnetic field the beam of cathode particles is deflected and the bright spot on the glass changes its position. The electrostatic force acting counter to the magnetic causes the beam to occupy more nearly its original position. When these two opposing forces are equal the phosphorescent spot occupies its original position. Thus, we have an easy and efficient means of determining when these two opposite forces are equal. When they are, $vem = se$.

Knowing now the value of v, and having previously determined, as we have seen, the ratio of e to vm, we have the value of $\frac{e}{m}$ which is the quantity desired.

THE RATIO OF $\frac{e}{m}$ CONSTANT FOR DIFFERENT GASES.

Using a somewhat different method J. J. Thomson found at first (1897) that *the ratio $\frac{e}{m}$ was a constant, whether the gas in the tube was air, carbon dioxide, methyl iodide or hydrogen.* This is a most important fact, as we shall see.

Thomson and his coworkers then changed the nature of the metal of which the cathode was made, using platinum, aluminum, silver, copper, tin, zinc, lead and iron, to see whether the nature of the metal from which the cathode discharge takes place has any effect on the value of the ratio $\frac{e}{m}$. *They found the same value for $\frac{e}{m}$, regardless of the nature of the metal of which the cathode was made.*

Thomson found the value of $\frac{e}{m}$ was equal to about 1×10^7.

THE RATIO $\frac{e}{m}$ VARIES FOR THE DIFFERENT IONS OF ELECTROLYTES.

It will be remembered that the value of $\frac{e}{m}$ for the ions of electrolytes varies with every ion. This is necessarily the case, since the charge carried is the same for all univalent ions, (and this quantity multiplied by the valence for all polyvalent ions as is seen from Faraday's law), and the mass varies with every cation and every anion. Taking the ion characteristic of acids, hydrogen, the value of $\frac{e}{m}$ for the hydrogen ion is 1×10^4.

It is, therefore, obvious that the *value of $\frac{e}{m}$ for the cathode particle is one thousand times as great as the corresponding value for the hydrogen ion produced when any acid is dissolved in a dissociating solvent.*

Knowing the values of $\frac{e}{m}$ in the two cases does not tell us anything about the relative masses of the hydrogen ion in solution, and the particle in the cathode discharge; since the charges carried in the two cases might be the same or might be very different. Before answering this question we must know the relative charges carried by the ion in electrolysis, and by the cathode particle.

THE VALUE OF $\frac{e}{m}$ FOR GASEOUS IONS PRODUCED BY DIFFERENT MEANS.

Before taking up the beautiful method for determining the value of the charge carried by the cathode particle, we shall ask and answer the question whether the value of $\frac{e}{m}$ for gaseous ions is the same, regardless of the means by which the gaseous ions are produced, or whether it varies with the means employed to produce the ions in the gas?

The answer to this question is unmistakably given by the results that have been obtained. The Lenard rays are nothing but cathode rays that have

escaped from the so-called vacuum tube by passing through a thin sheet of aluminum foil. The value of $\frac{e}{m}$ for the particles in these rays has been found to be 6.5×10^6.

The value of $\frac{e}{m}$ for the gaseous ions produced in contact with incandescent metals is about 8.5×10^6.

The value of $\frac{e}{m}$ for the gaseous ion produced by ultra-violet light is about 7.5×10^6, while the value of $\frac{e}{m}$ for the negative ion given off from radioactive substances is about 1×10^7.

It is obvious that the above values all refer to the negative gaseous ion. We see from the results that the value of $\frac{e}{m}$ for this ion is practically constant, regardless of the means by which it is produced, and regardless of the nature of the gas from which it is produced.

As to the value of $\frac{e}{m}$ for the positive ion of gases, we shall have something to say in a later paper, and shall also discuss the nature of this ion.

The "Accelerometer."

In the *Philosophical Magazine* (London) for August, Mr. F. W. Lanchester describes an instrument which he calls the "accelerometer," which is used for measuring and recording the starting and stopping efforts in vehicles. The instrument consists of a very short pendulum, to which is attached a pointer, this being a prolongation of the pendulum rod. Above the instrument is placed a horizontal scale. The movement of the pendulum is damped by a dashpot. The instrument works upon the principle that the sum of the driving and retarding forces is shared by all parts of the vehicle, and therefore the tractive effort on the whole vehicle can be measured by noting the deflection of the heavy pendulum. The tangent of the angle which this pendulum takes is proportional to the acceleration, and this is measured directly on the scale by the long pointer mentioned above. When, however, the vehicle is running upon a grade, the acceleration is no longer measured, although the instrument indicates in every case the actual tractive effort.

ELECTRIC ELEVATORS—II.[1]

MAGNET CONTROLLERS.

BY E. R. CARICHOFF.

Most of the petty interruptions to electric elevator service have been due to failure of controlling devices. Bad design, flimsy construction, insufficient capacity, unless cared for with infinite pains, are sure to cause all kinds of annoyances, and sometimes real accidents. Happily for the industry an important advance toward greater security was the abandonment, by the most progressive designers, of knife contacts for switches and sliding brush contacts for changing resistances on controllers when there is almost continuous operation.

Switches that may be called upon to break comparatively large currents as many as 5,000 times a day without failure and with a minimum of attention given but once a day, or even less often, must necessarily be of especially good design; and to my mind the most suitable design of contact for such a switch is that in which slightly rounded surfaces are brought together firmly and separated quickly by magnetic attraction and release. The final pull of a magnet is peculiarly adapted to produce the pressure required for good contact, and the spring of the contact ensures quick release. The parts of the contacts should come together with a rolling or a wiping action, which serves to clean the surfaces and to afford good electrical connection, and on release there should be sufficient leverage exerted to overcome any welding action of the current in case it exists. Copper surfaces with carbon auxiliaries or magnetic blowouts are used for large currents.

I regard this form of switch as the greatest improvement that has been made in the design of frequently operated controlling devices.

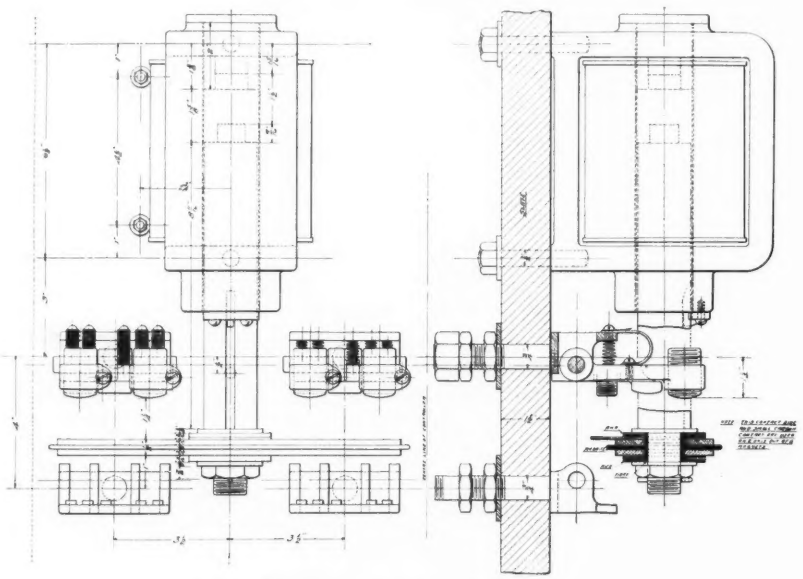


FIG. 1.—SECTIONAL VIEWS OF MAGNET SWITCH.

One variety is known as the "Contactor," of the General Electric Company. It requires the minimum of attention and maintenance as used on the multiple-unit train controllers. Another earlier variety has been used on Sprague elevator controllers, and a switch of this type of large capacity is shown in Fig. 1. The controller, shown in Fig. 2, is only a group of such switches, with cast-iron grid resistances, suitably mounted and connected

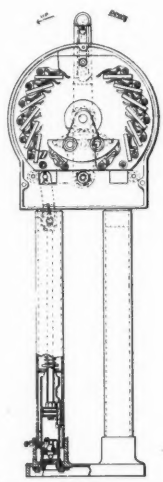


FIG. 2.—CONTROLLER.

[1] For the first article of this series, entitled "Fundamental Features of Electric Elevators," see ELECTRICAL REVIEW, June 24.

to replace the earlier pilot motor controllers of the Sprague-Pratt screw elevator.

Six of these controllers were installed more than a year ago at 20 Broad street, New York city, and up to this time there has not been a single interruption of the elevator service on account of the controllers, and indeed there have been very few interruptions due to any cause since the installation of large screws and ball nuts with five-eighths-inch balls.

As I have stated in the previous article, these machines use current from the line when running in one direction only, the car and its load driving the machine in the other direction, as is the practice with hydraulic elevators.

A controller is primarily designed to give the various speeds required and afford the proper stops. How this is accomplished in the type of controllers here considered is shown in the accompanying diagram. (Fig. 3.) There are two armature circuits on the controller: one, a variable resistance circuit for the motor when connected to the line, and the other a variable resistance circuit for the motor when acting as a closed-circuit generator. The operating switch at the left is the car-switch, the other is on controller board for testing purposes. The same magnet switches control both circuits, being provided with insulated bridging-pieces for connection with either the upper or the lower set of fingers. In general, the magnets are lifted to give an upward movement of the car and dropped to bring it down, the up-speed depending upon how many magnets are lifted, and the down-speed upon how many are released. The system is semi-automatic, which prevents the operator from making too violent changes of speed and yet affords positive and certain control of the motor, as the speed depends upon the position of the car-switch handle. This switch is entirely enclosed, is self-centering, and has a regulating mechanism within to prevent too rapid up-starting or too abrupt down-stopping of the car. It is shown in Fig. 4.

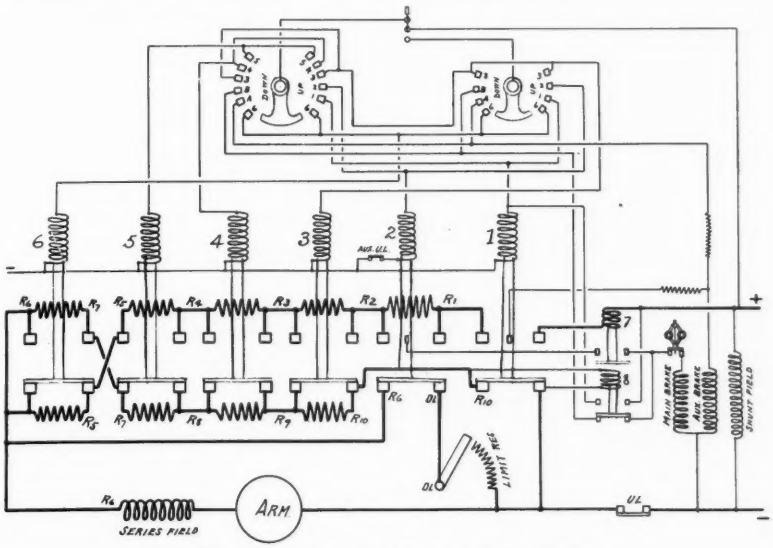


FIG. 3.—DIAGRAM OF CONTROLLER CIRCUITS.

Fig. 1 shows so well the construction of the switch contacts that minute description is unnecessary. There are five independent fingers pivoted in each terminal block, three of copper and two with adjustable carbons.

Referring to the diagram of circuits, Fig. 3, the following description will show the method of operation:

On the off-position the operating handle of the car-switch, as may be seen from the figure, is locked in centre. The magnets numbered 1 and 2 are used for upward movement only, while magnets 3, 4, 5 and 6 are used for both up and down.

On the first movement of the car-switch handle for an upward trip, magnet 6 is lifted, next 1, and then 2, when car starts up slowly. This movement may be made rapidly. To make a stop from a slow movement of car, return the handle just far enough to drop magnet 2 and hold 1 and 6 until the car stops, then move the handle to the centre. When 6 and 1 are held, the brake is on with part pressure and a holding current passes through the armature. When 1 is dropped the brake is on full and the main current is entirely cut off.

Advance of the handle from position 2 is retarded by an intermittent dash-pot in the switch, thus preventing a too sudden increase of speed. Magnets 3, 4 and 5 are then lifted in succession and 6 is dropped; each step increasing the velocity of the car up to full speed. Obviously any speed position desired may be retained. To stop short when running at full speed upward requires about five feet of car travel and is done by returning the handle quickly to the centre. Magnet 1 is held up automatically by magnet B on such a quick stop from full speed, but it must be held up by keeping the car-handle in the proper position on a stop from slow speed.

First movement of handle toward down lifts magnet 6 and then eases the brake through contact A, and the car starts down very slowly, making movements of one inch possible. Further movement of the car-switch handle lifts the brake clear by means of contact B, and still further movement of the handle increases the speed as magnets 3, 4 and 5 are lifted and 6 dropped in succession. The handle may be moved rapidly to full down-speed, and it may be returned rapidly to partly reduced down-speed, but the final movement to down-stop is automatically retarded in the car-switch. When a slow

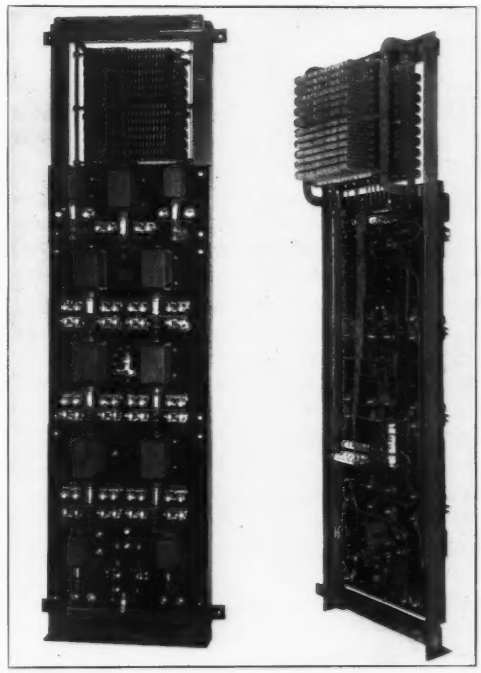


FIG. 4.—MAGNET ELEVATOR CONTROLLER.

movement of the car-switch is necessary, the dash-pot offers resistance and should not be forced.

The down-stop position is when contact A is just broken. After the car has come to rest the handle may be put in the centre, or advanced toward up rapidly until magnet 2 is lifted, when the dash-pot begins to retard and should not be forced.

To reverse quickly from full speed upward bring the car-switch to the first down-position and the car will come to stop, and start down very smoothly and slowly. The operation of these controllers gives the observer a feeling of confidence in the reliability, durability and safety of devices that affect so much the estimation in which electric elevators are held.

In a future article some equally reliable devices of cheaper construction for drum elevators will be described.

Report of the Royal Commission on London Traffic.

In February, 1904, a royal commission was appointed to report on the traffic of London. This report has now been made public. It is a large book of 150 pages, and includes a series of elaborate railway and tramway maps showing not only the present lines, but those suggested by the commission. In addition to this general report, special reports are to be made covering different phases of the work.

The area covered in the investigation is 692 square miles. This includes the residential districts, which was necessary in order to devise methods for handling the morning and evening traffic.

The population of greater London in 1901 was 6,500,000. The number of rides per capita per annum is 200, while that for New York is 300, and for Berlin 270, thus indicating statistically a substantial comparative deficiency. It is held that if the standard of movement in London can not be raised to the level attained elsewhere, London must fall behind in competition with other cities. The life and growth of the metropolis will slowly but surely strangle with the choking of the great arteries of traffic.

The commission estimates that at the present rate of increase the population of greater London in 1931 will be 11,000,000 persons. It also points out that the rate of increase of and requirements for facilities for locomotion is invariably greater than the increase of population. The only difficulty in the way of completely reorganizing London for purposes of locomotion is the question of cost. The ideal scheme is the construction in London of railways for purposes of long-distance urban traffic, and of railways radiating to the suburbs for purposes of suburban traffic, the railways, both in urban and suburban localities, being connected with tramways for short-distance distribution.

It is advised that a carefully-thought-out plan should be adopted for the future improvement of London, and while this has not been done by the commission, certain improvements have been suggested. One of these is a proposal for the construction of two main avenues through London: one four and three-quarters miles long, from west to east; the other four and one-half miles, from north to south. Each avenue should be 140 feet wide from house to house, and should contain subways for water mains. There should be four lines of tramway on the surface, and four lines of railway below the surface. The tramways on the surface are to connect the tramway systems at the end of the avenues. The railways underground are to connect the various railway systems of the city. It is estimated that the avenue running east and west, with its railway lines, would cost about $77,000,000; while that running north and south would cost about $42,000,000.

The problem of handling the cross traffic is dealt with partly. Three special routes are suggested, and it is recommended that steps be taken at once to prevent further obstacles to the future widening of existing streets. It is thought that wherever tramways can be laid on existing streets in London that they can be worked profitably. One of the disadvantages of the present systems is their lack of exchange facilities. Some systems of through routing should be developed. While it is thought that the omnibus, either drawn by animals or driven mechanically, will persist for some time, it is held that this is one of the chief causes of congestion in many of the streets. The commission thinks that the tramways are the most efficient and the cheapest means of street conveyance, and believes that their construction should not be postponed in the expectation that they will be superseded later by motor-driven omnibuses.

The needs of London in the matter of railway accommodation are main trunk railways connecting the city with the entire railway system of the country. There should also be railways to every suburban district in the neighborhood of London, and there should be railways through, across, and around the central area of the city to provide for greater speed in urban travel. The commission has come to the conclusion that when the "tube" railways already authorized have been completed, with the addition of a line suggested from Victoria to Marble Arch, the most pressing requirements of railway communication with the central area, as distinguished from the suburbs, will have been fairly provided for. However, more interchange stations should be provided wherever the lines intersect. For future extensions of the underground system the commission feels that it can rely upon private enterprise, but it should be seen to that this work is not discouraged.

The commission states that all large systems of mechanical traction can work most economically and with the greatest advantage to the public when they are under one and the same management, and it is believed that amalgamation can be carried out in such a way as to be profitable to the stockholders and advantageous to the public. This, however, should be sanctioned only on terms and conditions which fully secure the public interest.

The question of traffic regulation is discussed, particularly with reference to the obstruction caused by standing vehicles of all descriptions. Suggestions are made for the regulation of loading and unloading vehicles, routes, starting and stopping places of omnibuses, tearing up streets, peddling-carts, etc. It is recommended that a traffic board be established for dealing with the whole subject of municipal traffic. This body should also consider the question of street improvements and other allied matters.

The Submarine Cable to Iceland.

The Great Northern Telegraph Company, of Great Britain, has secured permission to operate a submarine telegraph between the Shetland Islands, Färoe Islands and Iceland. The course followed will be from the Shetland Islands to Thorshavn, then to the east coast of Iceland, landing at Seydis Fjord or Reydar Fjord. From the point of landing an overhead line will be carried to Regkjavik. The overhead line will be operated by a separate company, and will be financed by the Icelandish exchequer. The concession is given for twenty years, and can be renewed; or if the company does not desire to continue operating the cable, Denmark and Iceland are entitled to take it over without remuneration. As long as the concession holds other concessions to other companies are prohibited. It is anticipated that the cable will be put into service about October, 1906.

The Banquet of the Old Time Telegraphers.

One of the largest banquets ever held in New York city occurred at the Waldorf-Astoria Thursday evening, August 31. Mr. J. C. Barclay, assistant general manager of the Western Union Telegraph Company, presided, and Mr. Melville E. Stone, general manager of the Associated Press, was toastmaster. Mr. Barclay is always genial, and this occasion only served to increase the esteem in which he is held by the entire telegraphic fraternity. Mr. Stone's connections have led him into all quarters of the globe, and the Old Timers were fortunate in having this unusually brilliant gentleman to introduce the speakers of the evening. Among the guests of honor were Thomas A. Edison, Colonel Robert C. Clowry and Clarence H. Mackay. It was a gathering of the telegraph fraternity covering a period that extended from the invention of the telegraph to the present day. Ladies were included, and about 1,000 of both sexes were present.

Eloquent toasts were responded to, as follows: "The Old Timers," Colonel Robert C. Clowry; "The Telephone," U. N. Bethell; "The Telegrapher as a Factor in Intellectual Progress," Thomas F. Clark; "The Ladies," Henry D. Estabrook; "Our Friends Across the Sea," T. W. Goulding; "The United States Military Telegraph Corps," Colonel William B. Wilson.

Music and songs, several of the latter written especially for the occasion by Thomas E. Fleming and M. H. Kerner, were interspersed.

A very beautiful menu in colors, carrying a photograph of Samuel F. B. Morse, from the house of the James Kempster Printing Company, was admired by all, and a particularly unique souvenir in the form of a miniature telegraph key was presented to each guest. This key, which was manufactured by J. H. Bunnell & Company, was perfect in every detail, and yet was so small that it could be used almost for a watch-charm. It was greatly prized.

The floral decorations were unusually attractive, and the whole occasion was one which reflected great credit on the management, and will be considered a red-letter evening in the lives of all those in attendance.

The gathering included the Old Time Telegraphers' and Historical Association and the Society of the United States Military Telegraph Corps. Among those present were the following: At the speaker's table—J. C. Barclay, William H. Baker, B. Brooks, E. C. Bradley, U. N. Bethell, R. C. Clowry, Thomas F. Clark, P. V. DeGraw, Henry D. Estabrook, Thomas A. Edison, George H. Fearons, T. W. Goulding, Jules Lombard, Clarence H. Mackay, J. T. Odell, Charles W. Price, Melville E. Stone, J. B. Shale and William B. Wilson. Among others present were: Henry L. Shippy, James Kempster, Henry W. Pope, C. P. Bruch, F. W. Jones, J. B. Van Every, E. Rosewater, W. E. Gilmore, Charles Selden, Theodore L. Cuyler, Jr., E. C. Platt, George H. Usher, E. H. Bates, Samuel A. Duncan, G. W. E. Atkins, W. J. Dealy, M. R. Cockey, J. J. Ghegan, S. E. Barton, T. J. Smith, P. T. Brady, W. N. Eastabrook, Fred Catlin, William Maver, Jr., and Henry A. Reed.

Production of Radium from Uranium.

The various series of experiments which have been made public, and which were thought to indicate that radium is a disintegration product of uranium have been discussed by Mr. Bertram B. Boltwood. A kilogramme of the "purest uranium nitrate" was obtained, which was dissolved in distilled water and recrystallized five times. Of the purified material 100 grammes were dissolved in pure distilled water and introduced into a glass bulb with a capacity of about 400 cubic centimetres, and diluted to about 250 cubic centimetres. The neck of the bulb was drawn out into a short capillary and sealed in the flame of a blowpipe. The sealing took place July 8, 1904. Thirty days later the bulb was opened under conditions which precluded the escape of any portion of the contained gases, and the entire gaseous contents removed by boiling. This gas was introduced into a specially prepared, particularly sensitive electroscope, but caused no increase in the leak of the instrument, although the latter would have indicated had there been 1.7×10^{-11} gramme of radium emanation present. The tube was resealed and tested again in January of this year, still with negative results. A similar test was conducted on August 2, 1905, 390 days from the commencement, and no evidence of the presence of radium emanation was even then obtained. The whole series of experiments was conducted in a laboratory carefully protected from contamination by the salts of radium or other radioactive substances. The electroscope used had been reserved for this particular research. These precautions, it is believed, eliminated all possible errors. The experiments are considered to indicate at least that one or more products of a slow rate of change must intervene between uranium and radium, and that there can be no direct transformation of the former into the latter.—*American Journal of Science.*

AMERICAN ELECTROCHEMICAL SOCIETY.

LEHIGH UNIVERSITY, BETHLEHEM, PA., SEPTEMBER 18, 19 AND 20.

The eighth general meeting of the American Electrochemical Society will be held at Bethlehem, Pa., September 18, 19 and 20. A number of the papers to be read at this convention have already been received, and are about ready for distribution. The hotel headquarters will be at the Eagle Hotel, and the sessions will be held at Lehigh University. A partial list of papers has been announced, as follows:

"A Standard Method of Measuring the Specific Resistance of Electrolytes," R. Threlfall.

"Notes on the Use of Aluminum as a Reducing Agent," Oliver P. Watts.

"New Gin Furnace for the Electrical Manufacture of Steel," G. Gin.

"Note on the Electrical Resistivity of Iron and Steels at High Temperature," G. Gin.

"An Electrolytic Process for Refining Silver," A. G. Betts.

"Notes on the Electrometallurgy of Antimony," A. G. Betts.

"Report on the Electrochemical Exhibits at the Louisiana Purchase Exposition, 1904," C. F. Burgess.

"Artificial Willemite," Chas. Baskerville.

"The Chemistry of Electrochemistry," W. D. Bancroft.

"Ammeters for Electrolytic Work," L. Addicks.

"Electrolytic *vs.* Sulphuric Parting of Bullion," F. D. Easterbrooks.

"Insulating Paints," M. Toch.

"The Utilization of Active Oxygen, Chemically and Electrically Produced," R. von Foregger.

Title to be announced later, N. M. Hopkins.

"Some Tendencies in the Design of Electric Incandescent Lamps," E. F. Roeber.

"The Chemical Separation of the Excited Activity of Thorium," H. Schlundt and R. B. Moore.

"Radioactivity of Some Natural Waters of Missouri, On the," R. B. Moore and Schlundt.

"Some Observations on the Influence of Arsenic in Pickling Solutions," C. F. Burgess.

"The Electric Smelting of Zinc," O. W. Brown and W. F. Oesterle.

There will be an exhibit of Voege's system of index collection of Swiss electrochemical patents by C. F. Carrier, Jr.

EXECUTIVE AND OPERATING STAFF OF THE WESTERN UNION TELEGRAPH COMPANY.

Those sitting are J. C. Barclay, assistant general manager; Colonel R. C. Clowry, president and general manager, in the centre, and Frank Jaynes, general superintendent, Pacific Division, San Francisco, Cal., on the right. Those standing are T. P. Cook, general superintendent, Western Division, Chicago, Ill.; Belvidere Brooks, general superintendent, Eastern Division, New York City, and J. Levin, general superintendent, Southern Division, Atlanta, Ga. The Western Union Telegraph Company was incorporated in New York, April 2, 1851, as the New York & Mississippi Valley Printing Telegraph Company, the name being changed to the present title in 1856. The company has absorbed a number of smaller operating telegraph companies, and is now established all over the United States and throughout the world. Its authorized capital stock is $100,000,000. It has nearly 200,000 miles of poles and cables, and 1,125,000 miles of wire, with some 25,000 offices.

Essential Features of Public Telegraph Service.

By J. C. Barclay, Assistant General Manager, Western Union Telegraph Company.

WHAT features of the telegraph service most appeal to the consumers and create a good will toward the supplying corporation? I would say that accuracy in the transmission of messages stands first and foremost. The average customer is not unwilling, as a rule, to overlook a not too serious delay in such transmission, and may even tolerate an indifferent looking copy so long as it is fairly presentable and legible, but he does expect, and indeed demands, that the contents of his message shall be correctly translated and not distorted into something different from the original text.

Next in point of primary importance comes the matter of the rapid transmission and prompt delivery of messages, the urgency of which is implied from the very fact that they are being sent by telegraph. Hence, every provision made in the way of call boxes, messenger service, the establishment of branch offices, and other conveniences for the furtherance of this object, contributes in no small degree to attract the attention and secure the good will of those for whom such conveniences are principally intended. In this particular connection, direct wire service is quite generally regarded as a most commendable, desirable, and in some cases indispensable feature by the busy patrons of the telegraph, who fully recognize and appreciate the fact that this kind of service not only quickens, but reduces the liability of error in transmission.

After these more essential points, a clear, neat, and legible copy most favorably impresses the telegraphing community, so much so in fact that the advantages and desirability of the typewriter for telegraphic transcriptions were quickly perceived upon its advent into the commercial world, and its use in large telegraph offices as a substitute for the irregularities and idiosyncracies of ordinary penmanship is now quite general.

It may be taken for granted that as a general rule every advance in the art, or improvement in the service, makes a greater or lesser impression upon the users of the telegraph, and has its influence in devoloping and fostering in them that spirit of amity and good will which supplying corporations should always strive for.

Of the various other features of the telegraph service tending to create a kindly feeling in the direction indicated, not the least effective are those coming under the head of civility, courteous treatment, etc.—in which matters of ordinary politeness, it need scarcely be said, the officials and subordinates of telegraph corporations should never be lacking in their intercourse with the public. The display of tact, good judgment, and an accommodating spirit on the part of employés having direct dealings with the public serve in many instances to smooth over shortcomings or other matters of difficulty calculated to seriously affect this friendly attitude, for which reason the personal element may be regarded as an important factor in the establishment and maintenance of that good understanding which forms so agreeable an accompaniment to the commercial relations existing between the supplier and the consumer.

To strengthen these business relations, the good will of the consumer is necessary and this can only be obtained through considerations of the character above described, the proper observance of which can not fail to bring about the *entente cordiale* so much to be desired.

A Well-Telephoned Territory.

By John C. Reilly, General Manager, New York & New Jersey Telephone Company.

PRACTICALLY every condition which may be considered to exist in any section of the country, which renders difficult the supplying of telephone service to a varied population, would seem to be presented in the territory within which the New York & New Jersey Telephone Company operates. The population is cosmopolitan, metropolitan, suburban and rural. The requirements of the manufacturer, the department store, the small retailer and jobber, the year 'round city resident, the suburbanite and the farmer each is to be met, and met with satisfaction.

Because of the geographical conditions, and also because of administrative and operative requirements, the territory has arbitrarily been divided into two divisions, known as the Long Island division, covering Brooklyn and Long Island, with executive offices at 81 Willoughby street, and the New Jersey division, comprising within its limits Richmond borough, or, as it is more popularly known, Staten Island, and the northern half of the state of New Jersey. The executive and administrative headquarters of this division are located at 160 Market street, Newark, N. J.

Like the various members of a family, these two divisions have features in common. Carrying the simile still further, they are as dissimilar in the variety of conditions presented as they well might be and still be located contiguous to each other. The New Jersey division has a large metropolitan section, comprising Jersey City, Newark and the surrounding towns; a section given over largely to manufactories, mills, etc., as are found in Paterson, Passaic and Hackensack; an exclusive suburban development, with which there is none other in the country to compare; within which district are found the Oranges, Montclair, Summit, Morristown and Elizabeth and the seacoast summer resort territory, which comprises Monmouth County. The wealth of Monmouth Beach, Elberon and Long Branch, and the great populated centres of Asbury Park and Ocean Grove are all located in this county, and along the Atlantic coast between Sandy Hook and Spring Lake.

Out of the enormous population residing within the northern half of the state of New Jersey, thousands daily find their way to Manhattan. Here, their education as to what might be expected from telephone service, has been most complete. The result has been, for many years, met and anticipated by the New York & New Jersey Telephone Company. Throughout this large area, the company has acquired properties on which have been erected buildings comporting with the general character of the various neighborhoods, thoroughly fireproof, and equipped with the most modern switchboards and apparatus. These large expenditures, seconded by the efforts of the company in the matter of supplying adequate and efficient

service, has met with a ready response by the population catered to.

As far-reaching and comprehensive as are the steam railroad and electric lines throughout this division, still more so may be considered the facilities of the telephone company. Its lines radiate in all directions, are of standard construction, with the result that when traffic is practically suspended by means of the steam and electric railroads, the residents of the rural section, or of the suburbs, are kept constantly in touch with the near-by centres of activity on the island of Manhattan. The residents of New Jersey have long appreciated that the "new way" was to telephone.

When it is considered that this company at the present time is serving its patrons in approximately 200 municipalities within this division, the feeling of cordiality and good will which exists may be best understood, and its cause justly attributed to the fair dealing and satisfactory charges for service.

Staten Island, while properly, and by city limits, is a portion of the greater city of New York, can in no wise be considered as a metropolitan district. The island is dotted with small villages and hamlets, which prior to January 1, 1898, enjoyed a corporate existence, each having its own identity. Its incorporation within the city of New York has failed to obliterate the lines which formerly existed. The residence development on Staten Island, while it has been rapid, will show within the next two or three years a greater increase because of the new transit facilities in the way of speedy ferries, which are about to be placed in the service.

Various sections of the country have, from time to time, been referred to by various writers as the "land of telephones and automobiles." To no restricted section of the entire country does this appellation so fittingly apply as to Long Island. These two modern means of rapid transit have not only found their greatest use here, but the development of both has been phenomenally rapid. To the resident of Long Island the telephone has appealed most strongly. The conveniences which it brings have been readily appreciated and telephone service has come to claim its own. The geographical location of Long Island is such as to make it a natural mecca, toward which hundreds of thousands naturally turn for temporary summer residence and for short-term outings. To other thousands Long Island possesses other attractions. As a place of year-round residence it is constantly attracting large numbers of those who have hitherto been content with the narrow confines of a three-story brownstone house or the still narrower ones of an apartment house in Harlem or on the Heights. Long Island, with its "good air, good water and good roads," has the best of telephone service. The New York & New Jersey company, in its development of Long Island, has largely discounted the future, realizing that the date was not far distant when all sections of the three counties, comprising the middle and eastern districts, would be given over to a large suburban residence development. This policy was adopted years ago, and has been scrupulously followed. To-day there is no section of the island, no hamlet, no settlement which is not reached by pay station or subscribers' lines. The thousands which go to make up the population of the numerous towns in Queens, Nassau and Suffolk counties have been annually attracted from Brooklyn, Manhattan and the near-by New Jersey and Connecticut towns. Granting and appreciating this, and bearing in mind the high quality of service to which these residents had become used, the New York & New Jersey Telephone Company has devoted its efforts to supplying service which would compare most favorably with that in the metropolitan district. This involved a development of the territory on a system of unparalleled dimensions, the taking over of each of the nearly 100 central offices rendering continuous day and night service, opening branch contract offices, and the employment of an unusually large and well-trained operating and maintenance force. All of this has resulted in just what was anticipated—an increasing number of stations, greatly increased local use and a corresponding increase in the toll-line traffic. A liberal policy has been pursued, not only in the way of low rates, but of trunk line increases and new pole lines, in the majority of instances preceding the appearance of the mason and the carpenter. The pay-station development has been carefully watched, and the casual tourist, automobilist or driver finds this convenience at almost every turn. The attractions of Long Island are like the "tales of the prophet," not the least of which is the efficient and comprehensive telephone service.

PROPER METHODS IN CONDUCTING PAINTING TESTS.[1]

BY GUSTAVE W. THOMPSON.

New paint materials are offered to the consumer from time to time, these paint materials having more or less value, but in regard to which the manufacturers, as a rule, claim a somewhat more universal merit than these paints in actual use would warrant. It is natural for the paint manufacturer to advocate the use of his product or products for every condition under the sun, because he hopes by this broad advocacy to increase their sale. If there is one principle, however, on which the members of this society are pretty well agreed, it is that there is no complete paint which is suitable for all conditions of exposure; that is, every paint must, at least, have its various components put together in different proportions according to the conditions of exposure to which it is to be subjected.

We believe that it is the business of the engineer to design the paint which he is going to use under any given conditions. We believe that the paint manufacturers are only too anxious to supply what the engineer may demand. If the engineer starts out to select a paint, his proper attitude is not to take any one of the prepared paints on the market and specify that, because the manufacturer tells him it is the best for the purpose in question; but it is his duty to make such experiments as are practical for the purpose of finding out what paint is the best for the conditions to which the paint surface is to be exposed. To examine a paint on a large scale is, of course, the most satisfactory way provided the paint turns out well. We are unquestionably of the opinion that the surest proof of a paint is its use, just as we are confident that the best way to detect a poison is to take it internally. The unfortunate part of the matter is, however, that the use of the paint in order to find its value may leave the user firmly convinced that this value is a negative quantity. Supposing that he is able to try a paint in a limited way on full-sized structures, and the result, while not a minus result, is really very nearly that—that is to say, suppose the result leaves him somewhat in doubt, how is he going to tell whether the fault lay in the paint or its method of application? How can he be sure that the relative failure of the paint may not have been due to inherent destructive conditions external to

[1] Abstract from a paper read before the American Society for Testing Materials, Atlantic City, June 30, 1905

the paint itself but peculiar to the structure painted? A painting test of this kind, properly called a "field test," is of inestimable value when accompanied by tests conducted under conditions all of which are known. These are what may be called "laboratory tests," and, if conducted with care and parallel to field tests, they act as a check upon the results obtained by these field tests and give a better basis on which to rest scientific conclusions. These laboratory painting tests, made with the intent of exposure under service conditions, should be supplemented by other laboratory tests which should parallel information enabling the engineer or paint chemist to determine the relative value of a given paint in advance of the results which are obtained by field or laboratory tests under service conditions. We must not reverse this order, however, and attempt to substitute purely chemical tests for exposure tests under service conditions until the laboratory tests have demonstrated their value.

By the term "painting tests" in our title, we have intended to include those tests which can be conducted with scientific accuracy, but which, at the same time, are as close as possible to ordinary practice so long as this accuracy is not impaired. Unfortunately, tests supposedly of this kind are in most cases without value. So much is this the case that laboratory painting tests are often spoken of in words of derision, as though they could be made to produce any result desired by the skilful manipulator of the brush. In most cases these painting tests are made by persons interested in exploiting certain products, whereas they should be conducted principally by the consumer. The primary cause for the lack of value which these painting tests usually show is that they are not conducted with sufficient accuracy. Tests of this kind should be conducted under the supervision of a competent engineer or chemist and with as much care as if a chemical analysis were being made.

Committee E has outlined a method of conducting painting tests for protective coatings, this method demanding proper attention to all those details which are essential to the obtainment of accurate results. These tests, when carried out by the subcommittee having them in charge, should prove of inestimable value. There are other paints, however, which, though "protective," are used for the purpose of producing a desired finish of appearance. Most paints are of this kind, and I propose, with your permission, to say a few words about painting tests made, using this class of paints.

Let us, to start with, take the question of the relative "covering power" of paints. To my mind, the term "covering power" has only one proper meaning; that is, the power to hide the surface painted. It is, as Dr. Dudley has pointed out, a function, first, of the light-destroying or absorbing power of the constituents of a paint, and, second, of the difference in refractive index between the pigment and vehicle. Whatever it may be caused by, however, we are more interested in the actual facts of the case than the reasons therefor. In comparing two paints for covering power, it is generally understood that these two paints should have practically the same color and be very nearly alike in tone, for the eye is not able to note accurately the difference in covering which exists between paints of different colors or tones. When we compare two paints of the same color and tone for covering power, our work is somewhat simplified when it is borne in mind that very few paints are homogeneous as regards pigment. Most paints contain several pigments, the principal one being a white pigment of some kind. Only with straight white or dark colors is the pigment likely to be homogeneous. Furthermore, with the colored paints consisting largely of white pigment, the tinting material is so fine that only a very small amount is usually needed to give the tint desired. In this case the actual covering power of the paint is principally dependent upon the white pigment present. Our greatest interest, therefore, centres around the covering power of white paints, for, when we wish to design a paint of a certain color, we usually select a given white paint and add to it such coloring materials as have the highest possible tinting power and of which, consequently, we have to add the least amount possible. The result is that, practically speaking, tests for covering power are demanded for white paints only, and it is of these that I desire to speak.

On the threshold of our enquiry, we are confronted by two difficulties: the first of these has to do with the amount of vehicle we are to use to get the "consistency proper for painting." In the present state of the art, there is apparently no method for determining this consistency; the consistency proper for painting is simply a matter of rule of thumb. There is nothing standard about this consistency; it may be one thing in winter, another in summer; one thing with a flat brush, another with a round brush, and still another with the squirt gun. We have a refuge, however, and that, it seems to me, is the only safe one. When we have mixed our paint to a "consistency proper," in our opinion, "for painting," let us record the formula on which we prepared the paint and let our report state this formula in full detail. If the paint was a prepared or ready-mixed paint, then the analysis of the paint should also be reported in as nearly formula form as possible. In other words, we may have difficulty in determining what is the consistency proper for painting, but we need have no difficulty in recording the composition of the mixture which was used in making a given test for covering power; and this, in the present state of the art, is all that we can ask. The second difficulty which presents itself is in the adoption of a spreading rate per gallon of paint. There can in practice, of course, be no standard spreading rate; and yet we have found that any white paint which has, according to our experience, a consistency proper for painting can be readily brushed out so as to cover 1,200 square feet to the gallon of paint when applied to a fairly smooth surface; and, in most cases, if it is not spread out at that rate the paint will run. We solve this difficulty of the spreading rate at which the paint is to be applied in the same way that we solve the difficulty in connection with the consistency proper for painting; that is, we simply make the spreading rate followed a matter of record. To illustrate, let us suppose that we have received two paints which we desire to compare for covering power; these paints we will say are prepared paints—that is, they have been thinned to "consistency proper," in the manufacturer's opinion, "for general painting." We would, first of all, analyze these paints to determine the formulæ on which they were prepared. Inasmuch as the pigments in the two paints may vary in composition and, consequently, in specific gravity, we make a determination of the weight per gallon of paint as received; and knowing the percentage by weight of the vehicle present, we calculate the percentages by volume of vehicle and pigment present, which gives us a somewhat better conception as to the nature of the paints. All the information we have thus obtained is recorded. Our next step would be to compare these two paints as to the relative ease with which they can be spread over the same area, without any particular regard to their covering power. If we find that they can be spread over the same amount

of surface, without, as is usual, great difficulty, we adopt a standard spreading rate for the two paints—say, 1,200 square feet to the gallon, one coat—and apply the paints to standard prepared surfaces at that rate; and, when we are through, we compare the paints for their covering power, or power to hide the surfaces painted. Now let us compare this method of making a painting test for the covering power of white paints with the method usually followed: Jones has a paint that he wants tested. He takes it to his friend Brown, the painter, and wants his opinion. Brown reports in a few days that the paint he received from Jones covered better than any paint he had ever used. Now, Brown may have been perfectly honest in making this report to Jones; but, unless the formula on which the paint was mixed and the rate at which it was spread are given, Brown's opinion is worse than useless.

We describe here more in detail our method of comparing white paints for covering power:

Use white pine boards, thirty inches long by ten inches wide and, approximately, one inch thick. Each end of the board is provided with a cleat having a tongue fitting into a groove on the end of the board and securely nailed on. The entire board, including the cleats, to be finished to the size given above. Three of these boards are primed with, we will say, the following paint mixtures: white lead paste, 100 pounds; linseed oil, one-third boiled, seventy-five pounds. No attempt is made to secure a definite amount of priming paint to the unit of surface; this, for the reason that the boards may vary considerably in their absorptive power. When this priming coat is dry, each board receives a diagonal stripe of lampblack in japan about one inch wide on one or both sides of the board, as may be desired. When this black stripe is dry, it is given a second coat of paint mixed to a consistency proper for painting, the formula being recorded. The weight per gallon of the paint so mixed is then obtained by finding its specific gravity and multiplying by 8.33, which gives the weight per gallon. Inasmuch as the board which we are using has a total surface of 680 square inches, all we have to do is to find what the ratio is between 680 square inches and the spreading rate at which we desire to apply the paint in order to find the fraction of the gallon which we wish to apply to each board. If the rate adopted is 1,200 square feet to the gallon, then we get the formula—680 square inches : 1,200 square feet :: 1 : x, the reciprocal of x being the fraction of a gallon of paint to be applied to each board, one coat. Having the weight of the paint per gallon we easily get the amount of paint by weight to apply to each board, one coat on all sides When this second coat of paint is thoroughly dry a similar coat is applied; and, when dry, the boards can be compared for the covering power of the paints on them. We mention the painting of three boards with each paint to be compared. The purpose of this is that variation in results are obtained between boards which are apparently painted in an identical manner. These variations are not great, but it is thought best to eliminate them, to a certain extent, by painting three boards and selecting the one giving medium results for comparison with boards painted with other paints.

Tests conducted along these lines, we believe, will give valuable and scientific results and will enable the intelligent person to draw safe conclusions.

Let me state here, by way of illustration of the usefulness of this method, one of the results obtained by tests comparing pure white lead and linseed oil with a mixture of white lead and a small amount of barytes with linseed oil. The pure white lead was mixed on the formula of 100 pounds of white lead paste to thirty pounds of linseed oil; two mixtures containing barytes were made on the same formula as the white lead and pure linseed oil, except that to the pure white lead was added an amount of barytes corresponding to ten per cent by volume of the white lead present and the amount of oil was also increased ten per cent, so that the mixed paint contained in each case the same percentage of pigment by volume and the same amount of oil by volume. Another mixture was made, adding twenty per cent by volume of barytes to the sample of white lead paint and a corresponding amount of oil. These three paints were then compared by the above method for covering power and spread at the uniform rate of 1,200 square feet to the gallon. The result was that both paints containing barytes showed a very perceptible diminution in covering power. Now, this illustration has not for its purpose the saying of anything in favor of white lead and against barytes, but simply to show that if the statement is made that a small percentage of barytes can be added to white lead without impairing its covering power, some explanation must be made as to the method by which such a result is obtained. If in any painter's hands the result has been found that the addition of a small percentage of barytes did not impair the covering power of the white lead, it must have been due either to the fact that less oil was used or that less surface was covered per gallon of the paint containing barytes than by the straight white lead.

Perhaps the most important test that can be applied to paints is a durability test—that is, a test as to the permanency of the paint film itself. Boards painted, as in the making of the covering power tests described above, can be exposed to the weather and the durability of the paint films observed. Durability tests, to be of value, should be conducted with the same care as the covering power tests. The formulæ on which the paints were mixed should be recorded, also the rate per gallon at which they were spread.

Quite recently, painting tests with a view to observing the durability of various paints were reported on to the International Association of Master Painters and Decorators and the results obtained were published generally in the paint journals. Undoubtedly, these tests were conducted conscientiously and the conclusions reported give honest opinions about the results obtained. We feel, however, compelled to question these results for several reasons which appear to me to be very important. In the first place, single boards only were painted with each paint and exposed. At least three boards should have been painted and exposed alongside of each other, and the board which showed results about the average of the three should have been selected for comparison with other paints similarly selected. Very frequently it will be found that two boards painted apparently in the same manner and with the same paint will show differences in results due to differences in the boards themselves. In the second place, the formulæ on which the paints were mixed are not stated with sufficient detail. In the third place, there is no information given as to the spreading rate at which the respective paints were applied. Considering any two of the boards, the paint on one board may have been twice as thick as on the other, for all we know to the contrary. We have very little doubt that the thicker the paint film, the greater its durability. This emphasizes the importance of having painting tests conducted under the supervision of the engineer or chemist. The ordinary master painter is, we believe, thoroughly competent to interpret results and to conduct field tests on full-sized structures; but, when it comes to preparing boards for exposure, special training is required, such

as the chemist or engineer only can be said to have.

To conclude, no matter what the painting test may be, whether it be of colored paints or white paints, whether it be with homogeneous or mixed pigments, whether it be for covering power or durability, the essential features that we should insist upon are that the formula of the paint should be stated fully; that the thickness of the film—or what is the same thing, the rate at which the paint is spread—should also be stated. These two requisites of proper painting tests should also be demanded in all tests for the permeability of paint films or their permanency, no matter how these tests may be applied. If we wish to compare two paint films for their permeability by the dextrine test, we should know, to start with, that these two films have approximately the same thickness. It is a safe assumption that the thicker the paint film, the less its permeability. If we desire to compare two paint films for their permanency, we should know that these two paint films are of the same thickness, as the elasticity and general life of the film are proportionate to its power of resistance to oxidizing influences, and the thicker the film, the more permanent are its inner parts.

Tramway for Removing Garbage.

Consul Moe, of Dublin, Ireland, reports as follows regarding the use of the tramway by the city corporation for the disposal of garbage:

The city corporation proposes to dispose of the city refuse by filling up the lowlands near Fairview, and contemplates using the tramway tracks for this purpose during the night hours when the traffic over the lines has ceased. The corporation has the power to use the tramways for such a purpose between midnight and seven A. M., so long as the company's traffic is not interfered with, but there is no obligation on the company to supply the power for running the cars. A committee of the corporation has requested that such power be furnished by the company, and as the wear and tear on the rails is slight, the request will be complied with. Power will be supplied for the purpose mentioned at a flat uniform rate of two cents per unit.

It has not as yet been found feasible to have a half-penny rate in Dublin, though such fares exist in Glasgow and other large cities in Great Britain. It is worth while to record the sentiment of one of the directors at the half-yearly meeting, who amid the applause of his fellow directors, stated that "as to the working of the tramways he always felt that as they had a great public right they were under a great obligation to serve the public well, and he tried to impress that on every one in the company."

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

ANNUAL MEETING, LAKE CHAMPLAIN, N. Y., SEPTEMBER 12, 13 AND 14.

The twenty-sixth convention of the Association of Edison Illuminating companies will be held at Hotel Champlain, Bluff Point, Lake Champlain, N. Y., September 12, 13 and 14.

As usual the papers that have been prepared and will be read at the convention will prove very interesting and it is therefore hoped that an unusually large attendance will be present. The following is a list of the papers:

(*a*) "Practical Experiences with Steam Turbines," J. A. Radford, Chicago.

(*b*) "Improvements in Steam Turbines," W. LeR. Emmet, Schenectady.

"Data on Various Manufacturing Requirements," E. W. Lloyd, Chicago.

"Refrigeration by Means of Electric Motors," G. W. Goddard, Philadelphia; H. K. Mohr, Philadelphia.

"Experiences with Tests on All Kinds of Lamps for the Past Year, Including Nernst Lamps," Dr. C. R. Sharp, New York.

"The International Electrical Congress at St. Louis," J. W. Lieb, Jr., New York.

"Magnetite Lamps and Mercury Vapor Arc Lamps and Mercury Arc Rectifiers in Connection with Electric Light and Power Service," C. P. Steinmetz, Schenectady.

(*a*) "Methods of Starting Up Large Interconnected Systems Quickly After Partial or Total Shutdown."

(*b*) "Instruction and Training of All Operating and Construction Men Who Work on High-Potential Apparatus and Construction," W. F. Wells, New York.

"Relative Merits of Discharging Batteries on Edison Systems through Reversible Boosters and through End-Cell Switches," Gerhard Goettling, Boston.

"The Use of Small-Sized Carbons in Alternating-Current Arc Lamps," G. N. Eastman, Chicago.

"Maintenance and Repair of Coal and Ash-Handling Machinery," Charles H. Parker, Boston.

"Practical Operation of the Nernst Lamp," W. T. Morrison, New York.

"Relative Advantages of Twenty-five and Sixty Cycles," Philip Torchio, New York; Wm. C. L. Eglin, Philadelphia.

The delegates are to be accompanied by ladies and a most interesting programme has been arranged for their entertainment, as well as for the entertainment of the delegates.

Lake Champlain has many attractions, such as bathing, boating, yachting, fishing, tennis and an eighteen-hole golf course. Contests will be arranged for golf, as well as other sports, for which prizes will be offered.

The convention closes on the night of September 14, and an invitation is extended by the president and Mrs. Joseph B. McCall to those in attendance to be their guests on Friday, September 15, on a trip to Au Sable Chasm, which is within a short distance of the hotel.

Water Power in Switzerland.

It is estimated, says the *Electrical Review* (London), that the water power available in Switzerland amounts to 600,000 horse-power, and as various concessions have from time to time been granted for the utilization of different sources, the question has frequently been raised as to whether the water power should be nationalized in order to prevent further falls from passing into private ownership. In fact, the federal council was asked several years ago by the councils to place itself in communication with the cantons with a view to the institution of uniform legal regulations in regard to water rights, and in particular in respect of expropriation, appropriate limitation in the granting of concessions, rights of reversion, and preferential rights of the state and the communes. Nothing has, however, been done in the direction of the carrying out of this suggested programme, but an action on the part of the grand council of the canton of Ticino may perhaps expedite the matter. It appears that the Baden Motor Company recently applied to the Ticino government for a concession to utilize the water power of the upper course of the Ticino river, and especially the falls at Piottino and Biaschina, although the application was subsequently modified so as to comprise only the latter. As the Gothard railway administration proposes to adopt electric traction and to draw upon these particular sources for water power, the management of the railway made representations on the subject to the Ticino government with the object of securing the rejection of the proposed concession to the private electrical company on the ground that the water power of the Ticino in the Livine valley must be reserved for the Gothard railway. These objections have led to negotiations between the Ticino government and the grand council of Ticino, but the latter has unanimously resolved to grant the concession to the Motor Company. It is expected that the federal council will now take into serious consideration the question of nationalizing the water power, especially as it is intended to utilize water power for the generation of electrical energy in connection with the projected conversion of the Swiss railways to electric traction.

Telephone Progress in New York City.

Rain, shine, heat or cold will make no difference this winter to the shopping public, at least to those who have residence telephones. The large department stores of New York city are at last waking up to the vast opportunities which are presented to them in the proper utilization of telephone service. The Siegel-Cooper Company has recently made a contract with the New York Telephone Company for the installation of over 1,000 telephones throughout its mammoth Sixth avenue store. Telephones will be placed within the reach of every sales person in every department, and purchasers can reach the particular counter they desire just as though they went to the store in person. All information desired about goods can be obtained, and telephone orders will be promptly delivered on approval. Furthermore, the store will be open night and day, telephonically, and the customer who can not reach the store before closing time can send in his or her order by telephone. Unquestionably this telephone feature will extend the scope of the store's business.

The convenience, the saving of time, the immunity from weather conditions will undoubtedly popularize this service to a marked degree.

There are now in service in the five boroughs of Manhattan, The Bronx, Brooklyn, Queens and Richmond, about one-quarter of a million telephones. Of this number a goodly proportion are installed in the residences and apartments of the better class of people, the very class that the department store desires to reach.

Another feature of this service is the value of intercommunication between the departments in the store. With telephones at every point of activity, a large volume of the detail can be transacted with ease and with a great saving in time. Furthermore, the convenience to customers in the store will be great, and many tedious, time-wasting journeys from floor to floor can be saved to the shopper who can call from one department to any other department in the store at will.

The Siegel-Cooper Company is to be the first in the field in New York city to install a comprehensive telephone system in its store, but the other department stores will unquestionably follow suit.

Another interesting phase of telephone development in New York city is the introduction of table telephones in restaurants. The telephone company has recently perfected an arrangement whereby telephone wires are brought to each table in the restaurant. A customer desiring to send a message, or one expecting a telephone call, can order a telephone brought to his table. The instrument is plugged in on the circuit and the customer may use the telephone at will during his meal.

This service bids fair to become very popular, not only in the busy downtown restaurants, patronized by business men, but it is also believed that this service will be very popular in the up-town establishments, the convenience of this appliance appealing strongly to ladies.

Although the extension of telephone service in New York city is very general, the saturation point has not by any means been reached. In Manhattan and The Bronx alone, a yearly gain of nearly 30,000 telephones is made.

The great efficiency of the service in New York city, together with the method of charging according to the use, is bringing the telephone into such favor that the officials of the company believe within a few years not only will there be a telephone on practically every desk of every commercial establishment in the city, but there will also be a telephone in practically every home. The future of the telephone certainly looks bright.

The Mariner's Yarn.

[A Remarkable Lightning Stroke. Respectfully referred to the lightning conference and to the marines.]

Down in the docks the other day they were talking about a schooner which had been struck by lightning, when the reporter singled out an old mariner, and said:

"Captain H———, it seems to me I've read or heard of your brig being struck."

"Yes, she was," answered the old yarn-spinner.

"Where was it?"

"Off Point aux Barques, about fifteen years ago. Very strange case, that. Probably the only one of the kind ever heard of."

"Give us the particulars."

"Well, we were jogging along down when a thunder-storm overtook us, and the very first flash of lightning struck the deck amidship, and bored a hole as big as my leg right down through the bottom of the vessel."

"And she foundered, of course?"

"No, sir. The water began rushing in, and she would have foundered, but there came a second flash, and a bolt struck my foreto'gallant mast. It was cut off near the top, turned bottom end up, and as it came down it entered the hole and plugged it up as tight as a drum. When we got down to drydock we simply sawed off either end and left the plug in the place."

The Frome, England, Electricity Works.

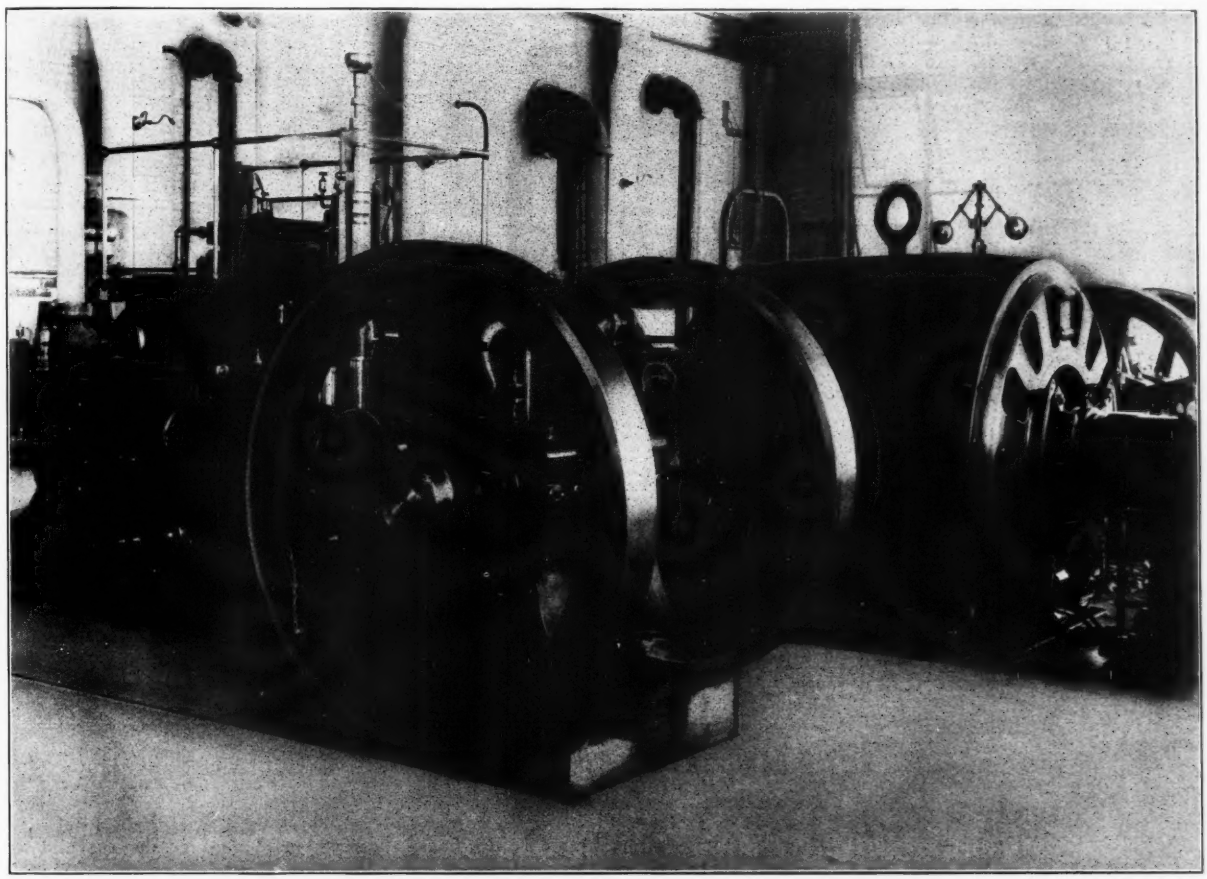
Frome is a small town of 12,000 inhabitants, situated in the eastern extremity of Somerset, England. It has recently installed a municipal electric light and power station to supply the public lights and private demands. The building is a structure of stone, divided into boiler house, engine room and battery room. There is in addition an office building containing the necessary general and engineer's offices, storeroom, workroom and a showroom. The coal bunkers have a capacity of about eighty tons. The boiler room is forty-eight feet long, forty-two feet wide and twenty-six feet high. It contains three Babcock & Wilcox boilers, two capable of evaporating 5,000 pounds of water per hour each, and one 7,000 pounds, at a working pressure of 160 pounds per square inch. The boilers are fitted with chain-grate mechanical stokers driven by four-horse-power electric motors, and are also provided with superheaters. As the local supply of water is very hard, a Boby-Chevalet heater and softener has been provided. The engine room is placed at the north side of the boiler room. It is forty-eight feet long, thirty feet wide, and eighteen feet high, and is spanned by a five-ton overhead traveling crane. The electrical equipment consists of three Parsons 530-volt steam turbine dynamos and accessories. Two of the machines are rated at 150 kilowatts, and one at seventy-five. This type of equipment was adopted partially on account of its freedom from vibration, as the foundations of that locality are exceedingly bad. The plant operates condensing, the condenser water being cooled by a tower. The condenser pump is driven by a twenty-horse-power electric motor. The distributing cables are placed underground in the soil, and covered with hard bricks. They are steel-armored. The feeders are triple concentric. The distributing mains are three and four-core, the former for the three-wire commercial system, and the latter for straight lighting. The battery room contains 260 cells with a capacity of 400 ampere-hours. Power is supplied either at a flat rate of fourteen cents and eight cents per kilowatt-hour for light and power, respectively, for the first hour, any additional being charged for at the rate of six cents and two cents; or a flat rate of twelve cents for lighting and five cents for power will be made. In some cases the supply is sold by prepayment meters at fourteen cents per kilowatt-hour. The total number of motors in operation on the system is now 102, ranging in size from thirty-five to one-quarter horse-power. The equipment in eight-candle-power lamps connected, including the entire system, is nearly 20,000, and the company is behind in making connections.—*Electrician (London), August* 18.

The New Station of the Hartford Electric Light Company.

A 5,500-Kilowatt Installation of Horizontal Steam Turbines on the Connecticut River.

SOME time ago it was realized by the management of the Hartford Electric Light Company, Hartford, Ct., that the demand on its system would soon be in excess of the output of its water-power stations—the Farmington River Power Company and the Tariffville station—and a reserve steam unit of 1,500 kilowatts capacity, in the form of a Westinghouse-Parsons turbine, was installed at the Pearl street transforming station where a complete new station has been built, the present normal capacity of which is 5,500 kilowatts.

The building is of brick and steel construction, with concrete foundations. Its length is 119 feet two inches, and its width ninety-seven feet. As the station is built largely upon a quicksand, considerable ingenuity had to be exercised to create a proper foundation. The station is built first upon a log mattress, the foundations



Dry Vacuum Pump and Generator End of Turbo-Generator, Hartford Electric Light Company, Hartford, Ct.

to help carry the load. Later, it becoming evident that additional power was required to meet the growing demands, and also to provide for ample supply in case of a severe season of drought, the decision was made to build an entirely new power station somewhere on the Connecticut river where ample water supply could be had and where there would be facilities for easily procuring a constant supply of fuel. A site was accordingly chosen at Dutch Point, on the Connecticut river, for the various units being especially piled. On top of the mattress is placed a flooring of five feet of concrete. The base of the wall foundation is concrete, five feet thick, and in a height of ten feet this batters back to two feet six inches. From the surface of the concrete flooring of the station to the floor of the boiler room there is a height of sixteen feet seven inches, the floor of the engine room being three feet higher. The boiler room is twenty-six feet five and one-half inches high to the bottom of the girders, and the engine room twenty-three feet five and one-half inches. The boiler room is 116 feet long by forty-four feet nine inches wide, and the engine room is 116 feet long by forty-six feet six inches wide. The walls of the building are of brick and steel, and the roof is of reenforced concrete suspended on steel girders. The roof has a gentle slope from the partition line between the engine room and the boiler room, and the boiler room is served by three large lighting and ventilating monitors. Twenty-six feet from the north end of the building, on the east side of the structure, is a room twenty-four feet six inches by seventeen feet three inches, built over the intake well, and containing the auxiliary apparatus for the circulating water.

The boiler room is equipped with six Aultman & Taylor 550-horse-power water-tube boilers. Steam is generated at 150

pounds gauge pressure, and passed through Foster superheaters, where it is superheated 100 degrees Fahrenheit. The superheaters are placed just above the upper row of tubes in each boiler, and the steam is taken from the superheaters through a loop to a twelve-inch main header, and from this main header by a short length of pipe through the brick wall, and then dropped down to the floor level, where connection is made to the steam chest of the turbine. Each boiler is equipped with the Parsons automatic blower system, this system working under a variation of about two pounds pressure. As the pressure in the boilers falls off, forced draft is applied, and as soon as the pressure reaches a predetermined point, the draft is immediately checked. For getting rid of the ashes a false ash-plate is removed and the ashes drawn into the ash-pit. Through the ash-pit the ashes drop down through a concrete-lined conical chute into cars which may be moved from point to point on the tracks in the basement below the boiler room. The ash chute is controlled from the pit underneath by a chain-operated gate. From the ash-pit the ashes are dumped onto an elevator and carried to the rear and side of the plant, where the land is being filled in.

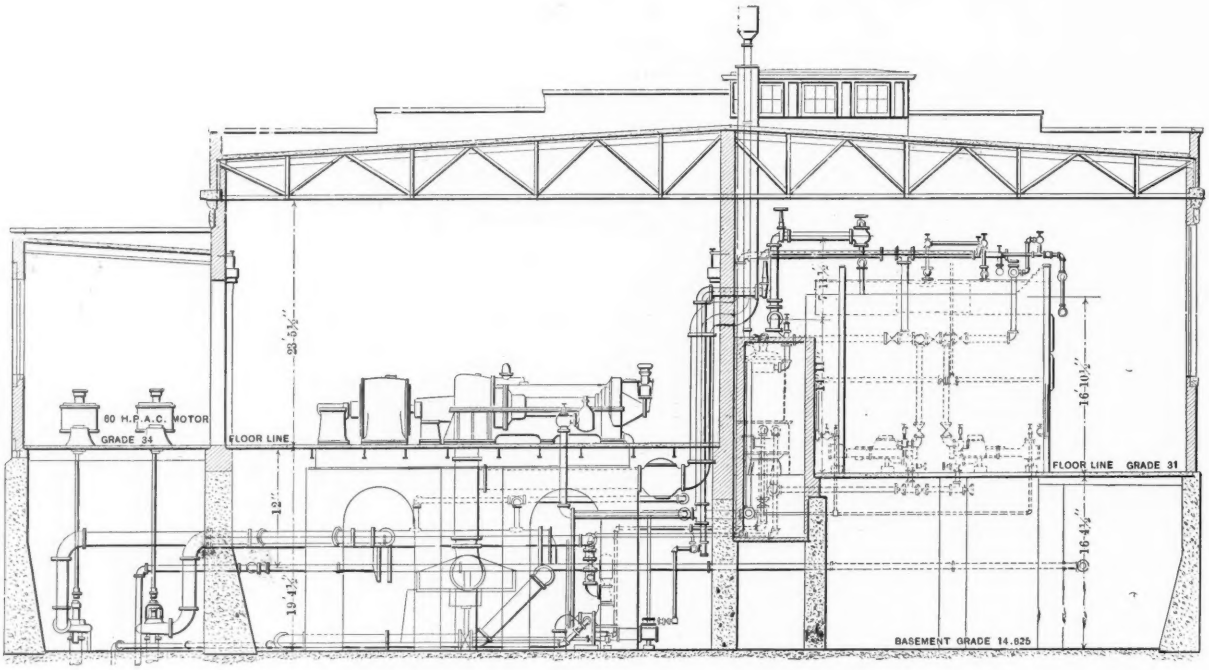
The boilers are hand-fired. The coal is picked up from the storage yard outside by a locomotive coal hoist, and dropped into a hopper, from which it is conveyed by chutes to hand-barrows manipulated by the stokers. Each barrow of coal is weighed, and the coal is served to the furnaces from immediately in front of the furnace doors. By this arrangement it is possible to use any mixture of coal, at the same time keeping an accurate record of the amount of coal being used each day. An auxiliary railway system has been built from the wharf on the Connecticut river to the rear of the power station, so that the coal may be taken either from the barges by the locomotive hoist and loaded into cars, or it may come in over a spur of the New York, New Haven & Hartford Railroad and be placed in any convenient position in the storage yard. Ample storage facilities have been provided for carrying the station over a period of from four to six months.

The products of combustion from the furnaces are delivered into a main flue which runs the whole length of the boiler setting. The flue is built entirely of brick, with retaining channel irons at the top and bottom. The flue is small at the farthest end, and increases in dimensions until it is six feet square at the entrance to the stack. The brick base of the chimney is eighteen feet square, and the steel stack is ten feet in diameter and 135 feet high.

All of the piping in the boiler room is in straight lines. The hot-water supply pipe and the cold-water supply pipe are side by side, suspended over and near to the front end of the boilers. The main steam header is behind the boiler setting, and about five feet below the tops of the boilers. The auxiliary apparatus in the station is served with saturated steam from an auxiliary steam header running over the tops of the boilers the whole length of the boiler room. This steam header is fed by short lengths of pipe directly from the drums of the boilers.

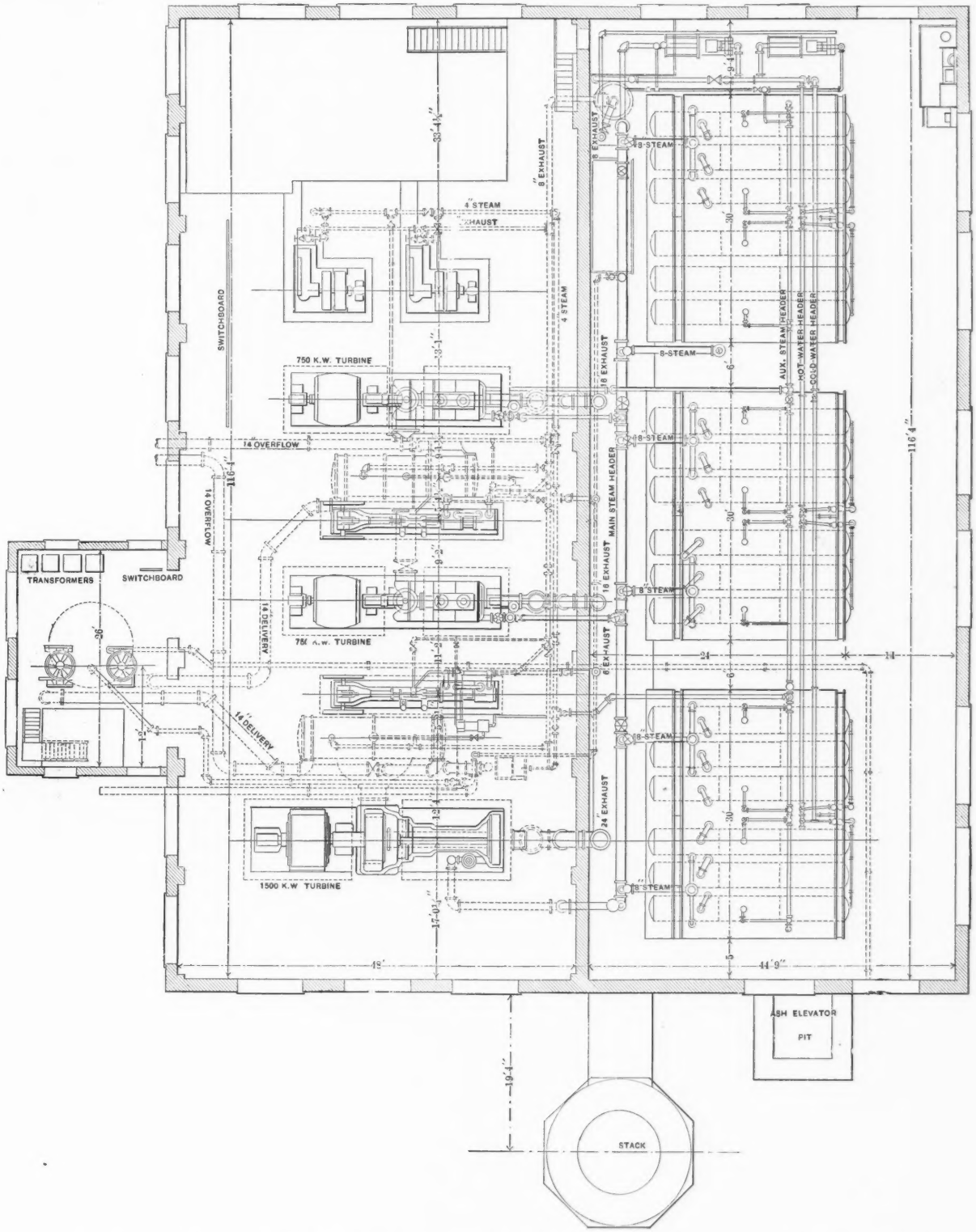
The boilers were originally filled with water from the city mains. The steam which passes through the turbines is condensed in surface condensers and used over and over again, the water being drawn from the hot wells; and the loss which occurs in the auxiliary system is made up by additions from the intake well. The auxiliary apparatus exhausts through a single feed-water heater.

In the engine room there have been installed two 1,000-kilowatt generators driven by Westinghouse-Parsons steam turbines. The generators deliver current at 2,400 volts, two-phase, 7,200 alternations, and run at 1,800 revolutions per minute. Twenty-eight inches vacuum is maintained by two Alberger dry-vacuum pumps eight by eighteen by eighteen by



General Arrangement of New 5,500-Kilowatt Turbine Station of the Hartford Electric Light Company, Dutch Point, Hartford, Ct.

twenty-four inches. These turbines are located in the central part of the engine room, and provision has been made for the installation of two other units—one of 1,500 kilowatts capacity, and one of 2,000 kilowatts capacity. Beginning at the north end of the station, the turbo-generators are designated as No. 1, No. 2, No. 3 and No. 4. Generators No. 2 and No. 3 are now in place. Generator No. 1, which is the 1,500-kilowatt unit, will be brought from the Pearl street station.



PLAN OF NEW 5,500-KILOWATT TURBINE STATION OF THE HARTFORD ELECTRIC LIGHT COMPANY, AT DUTCH POINT, HARTFORD, CT.

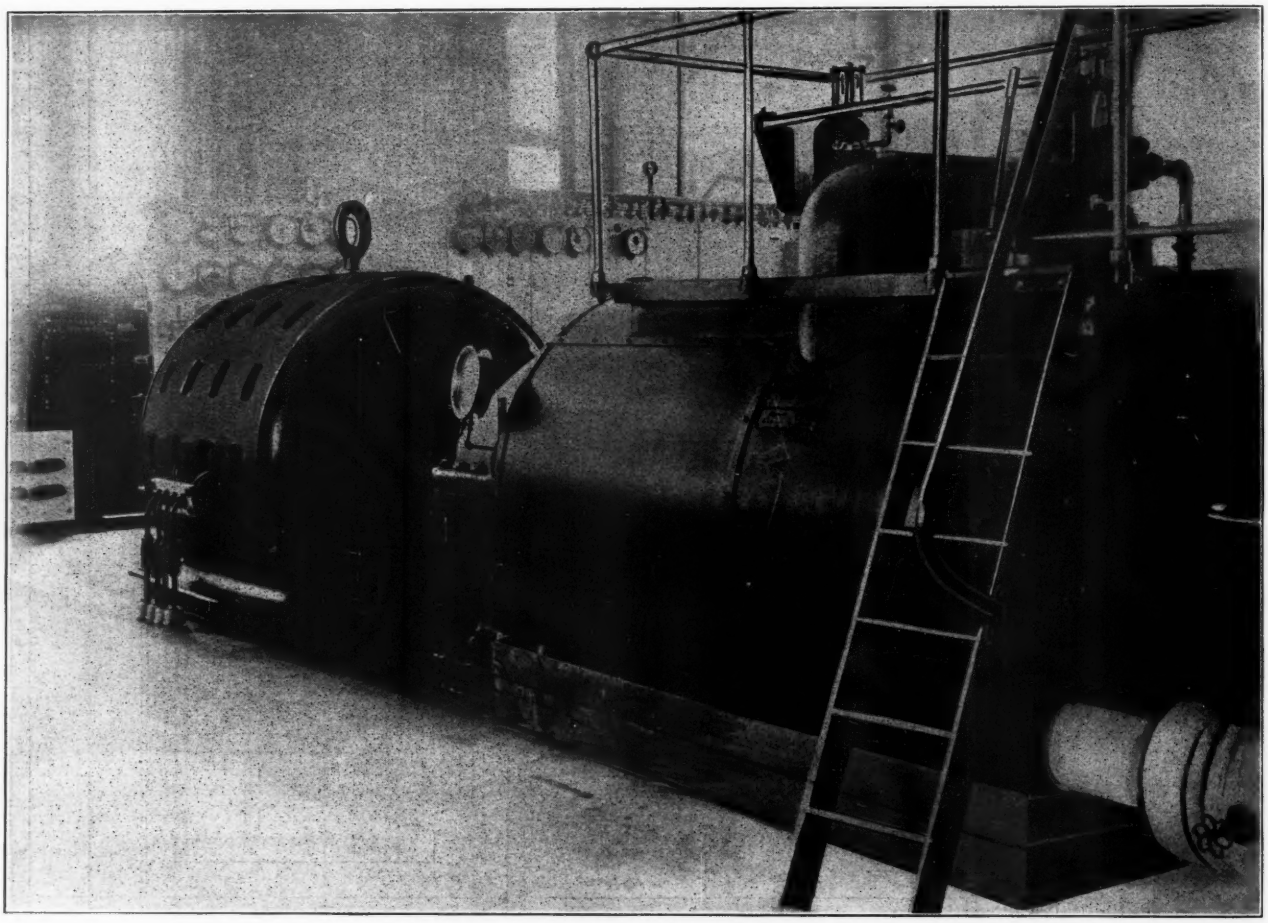
This unit has been in operation since early in 1902, and has given eminently satisfactory results.

The steam from the turbines discharges directly into surface condensers. These condensers are built up of probably 2,400 brass tubes. The front and rear ends of the condensers are fitted with baffle-plates, the water being forced to circulate first through the upper series of tubes to the rear of the condenser, where it falls part way to the bottom, meeting another baffle-plate which turns it back through the middle series of tubes to the front end of the condenser. At the front end it falls to the bottom part of the condenser, passes through the lower series of tubes, and out through the fourteen-inch overflow pipe.

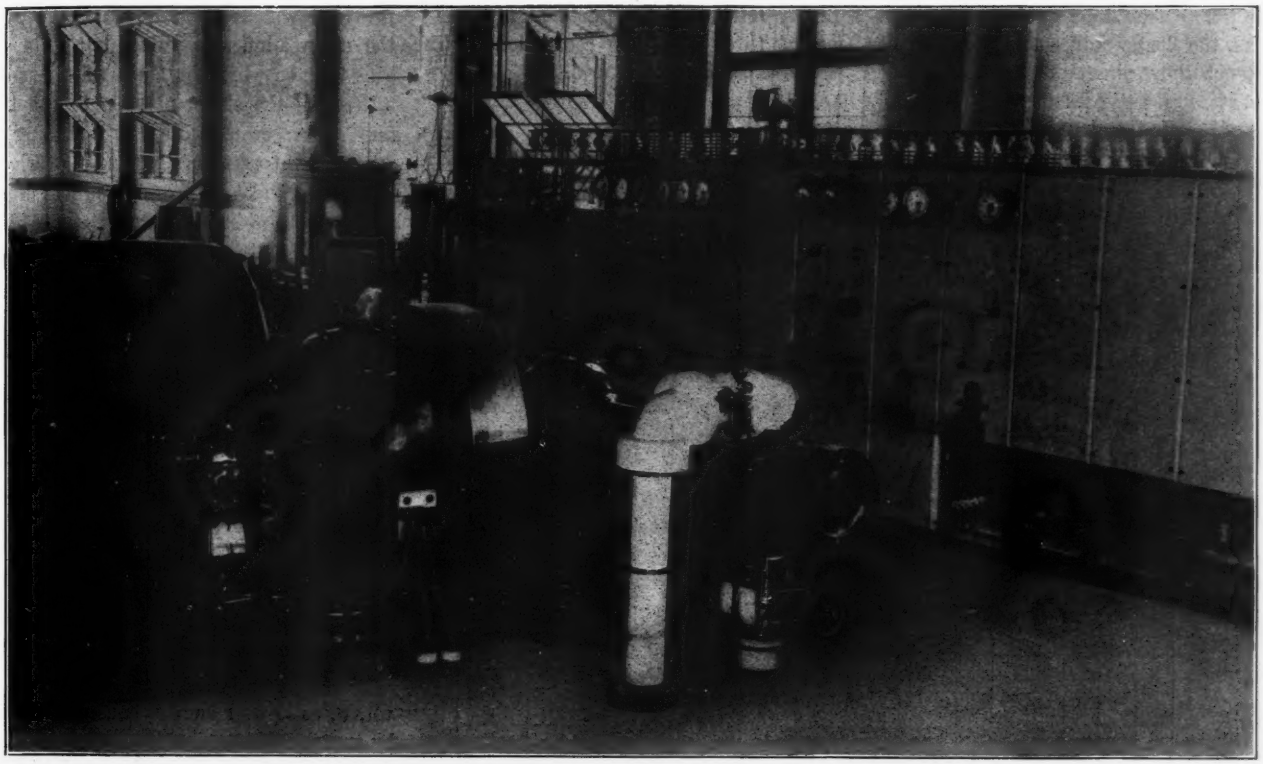
The circulating water is taken from an intake well ten feet in diameter, located near the river. This intake well receives its supply through a four-foot pipe leading from the river. The intake is provided with a trash rack and two settling-out screens, which keep from the condensers the larger portion of the river sediment. From the intake well the water is forced by centrifugal pumps through fourteen-inch delivery tubes to the three condensers. One condenser will take care of the two 1,000-kilowatt units; another will take care of the 1,500-kilowatt unit, and the third will take care of the 2,000-kilowatt unit. The centrifugal pumps are driven by Westinghouse vertical, fifty-horse-power, constant-speed induction motors. These motors run at 580 revolutions per minute, 200 volts, two-phase, 7,200 alternations. Each motor is fitted with an autostarter mounted on the motor frame. Series transformers step down the current from 2,400 volts to 200 volts for the operation of the motors. There will be four pumps installed altogether, one of which will be used as a reserve. The condenser serving the generating units No. 2 and No. 3 is fitted with two hydraulically operated valves. These valves are interposed between the turbine and the condensers. The valves are so by-passed that either city water or boiler pressure can be used. A sixteen-inch atmospheric exhaust pipe is fitted to each turbine, should it become necessary to run any of the turbine apparatus non-condensing.

The condensed steam from the turbines is passed directly to hot wells, and from the hot wells the water is pumped to a storage tank. From this tank the water is passed by the boiler feed pumps through the heater direct to the boilers. The boilers are served by two Deane plunger-type pumps seven by twelve by ten inches.

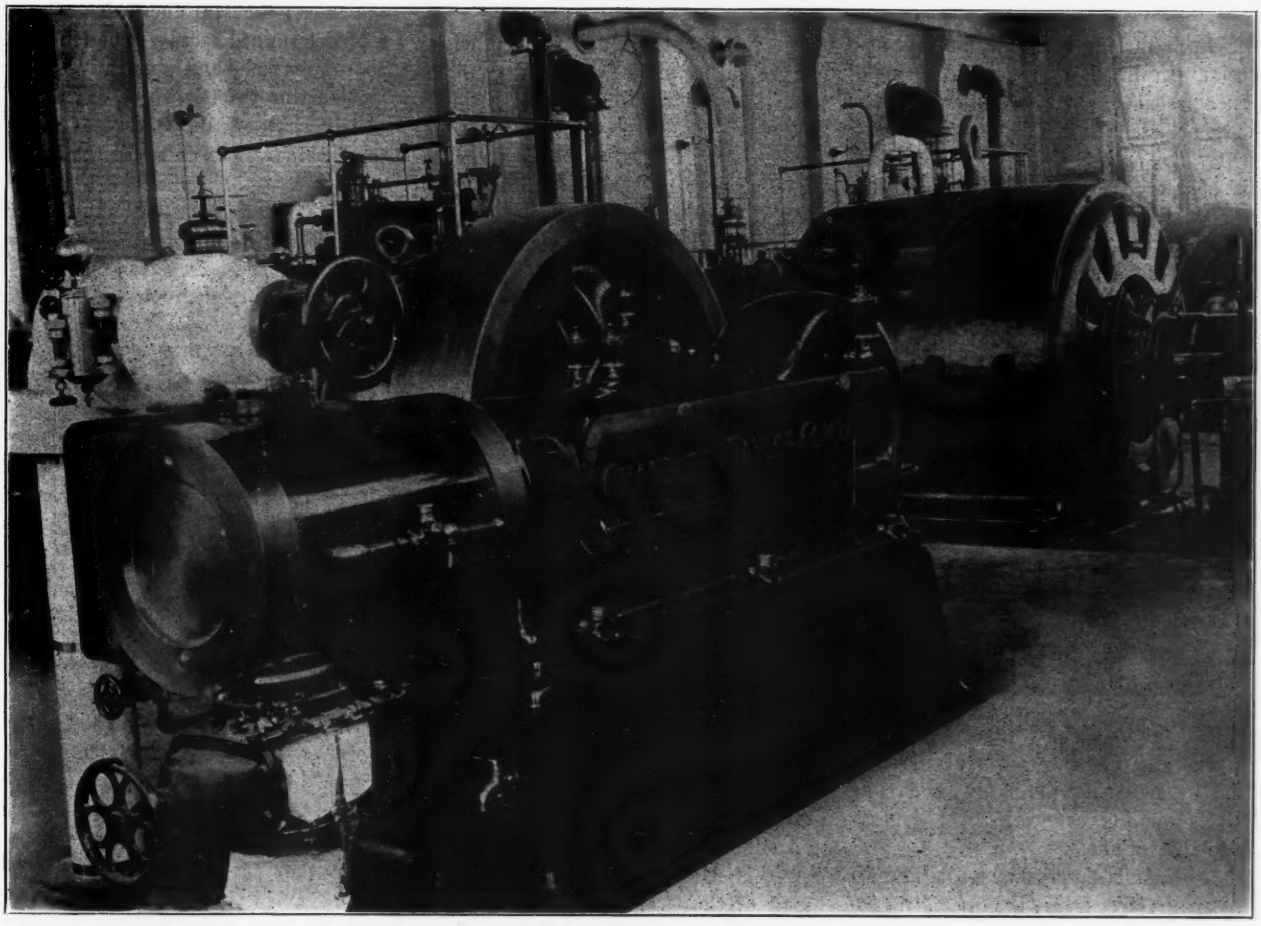
A Deane duplex piston-packed pump takes water from the intake well and raises it to a tank under the roof just over the boilers. This pump has an automatic governor on the steam end, and is controlled by a float valve on the water end. The water is used as a seal, under a pressure of about five pounds, for the low-pressure glands in the steam turbine. This does away with mechanical packing and eliminates any friction which might result. The tank also serves to make up the steam lost in the auxiliary line. The float acts on the city water supply pipe that leads to the tank. If, for any reason,



1,000-Kilowatt Westinghouse-Parsons Turbine, Hartford Electric Light Company, Hartford, Ct.



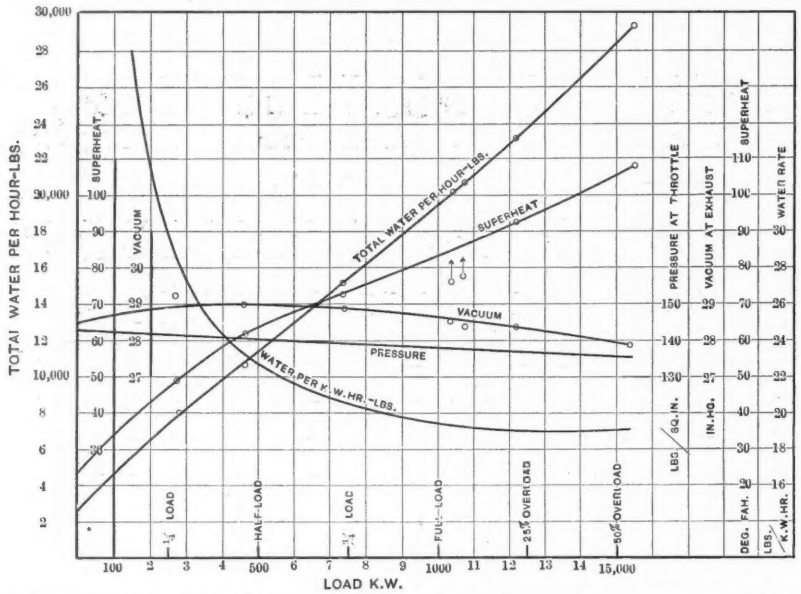
Exciter Engine and Switchboard, Hartford Electric Light Company, Hartford, Ct.



View in Engine Room of New Turbine Station, Hartford Electric Light Company, Hartford, Ct.

the pump should be shut down for repairs, the float would act to open the city water supply pipe. If there should be an excess of water in the tank the supply pipe to the steam pump would be throttled.

The construction of the turbine units conforms to the builders' standard practice. Each turbine is of the multiple-expansion parallel-flow type with a single rotating element and a stationary element, or casing, of corresponding diameters, and split horizontally through the axis of the machine. This enables the cover of the turbine to be removed in very short order, whereby access is obtained to the entire interior of the machine for inspection. The motor may then be lifted out by crane without disturbing the generator or other parts of the machine by removing the bolts in a split flexible coupling connecting the generator to the turbine.



Economy Test of 1,000-Kilowatt Steam Turbine, Hartford, Ct., April 6, 1905.

Lubrication is supplied by a small pump driven directly from the turbine, delivering oil at a slight static head, which finally returns to the pump after having passed through a pipe cooler located in the bed-plate of the turbine. This system provides an endless circulation for the oil, preventing waste and at the same time rendering each unit entirely independent of outside auxiliaries in the matter of lubrication.

An important feature is a provision for preventing air leaks into the vacuum space through the shaft-packing glands, as it is a well-known fact that a small amount of air will largely reduce the vacuum that may be carried. At each opening the turbine shaft is fitted with frictionless-packing glands operating on the turbine principle and sealed with water for which only a very small quantity is necessary, finally finding its way into the condenser. No oil is used in these glands, and none enters the turbine from any source.

Another distinctive feature of the machine is the provision for sustaining heavy overloads. For this purpose an auxiliary or secondary admission valve is provided which resembles in all respects the main admission valve, but only begins to open when the main valve has admitted all the steam possible to the turbine, *i. e.*, at a point corresponding to ten per cent to fifteen per cent overload.

This secondary valve introduces high-pressure steam to the later stages of the turbine; thus greatly increasing its capacity. Over 100 per cent overload has been carried by some machines by means of this valve, and with only a slight reduction in economy.

By the system of governing employed a very close regulation may be obtained—from one per cent to two per cent—if desirable. Futhermore, the turbines may easily be synchronized while running by means of a governing spring adjustment which changes the tension of the spring and, consequently, the amount of steam admitted at a definite speed. Finally, this adjustment is useful for dividing the loads between machines operating in parallel, which, as is well known, can not be done by means of changing the generator field resistance. In the remote possibility of the governor breaking or failing to work, an automatic safety stop is mounted at the end of each turbine which releases at a predetermined speed—some ten per cent above normal—and instantly closes a quick-acting throttle which serves to completely shut off the supply of steam to the turbine. The unit will then come to rest unless still connected through the electrical end to other machinery operating in parallel with it.

A curve sheet is shown herewith, the result of an economy test conducted by the National Electric Light Association at Hartford, April 6, 1905.

The accompanying data are also given to indicate the performance of the 1,000-kilowatt unit during this test.

Exciting current is generated by two ten-by-twelve Chandler & Taylor engines, direct-connected to fifty-kilowatt, 125-volt

PERFORMANCE TEST OF 1,000-KILOWATT WESTINGHOUSE-PARSONS TURBINE, HARTFORD, CT., BY NATIONAL ELECTRIC LIGHT ASSOCIATION TESTING COMMITTEE.

Duration of Test.		Load.		Pressure Throttle Gauge.	Superheat Degrees Fahrenheit.	Exhaust Pressure. Inches.	Vacuum. Inches.	Pressure By-pass Valve Chest.	Water Consumption.			Water Rate. Pounds per Kw-Hr
Time.	Hours.	Kilowatts.	Per Cent Rating. Overload.						Total Number Hours.	Water Seal Number Hours.	Net Number Hours.	
8.05– 9.05 P. M.	1	1,546.4	54.6	135.0	108.0	2.19	27.81	114.5	30,172	939.0	29,347.5	18.98
6.55– 7.55 "	1	1,219.3	21.9	137.1	92.4	1.70	28.30	106.5	23,933	852.0	23,187.5	19.02
2.50– 3.50 "	1	1,071.5	7.2	137.7	77.7	1.70	28.30	75.0	21,281	765.0	20,591.0	19.22
8.30– 9.30 A. M.	1	1,047.6	4.8	137.2	76.0	1.57	28.43	68.0	20,900	796.5	20,171.5	19.26
10.40–11.40 "	1	735.8	73.5	138.6	72.9	1.21	28.79	43.5	16,000	829.5	15,214.0	20.68
12.00– 1.00 P. M.	1	463.0	46.3	140.7	62.1	1.01	28.99	23.0	11,559	911.0	10,671.0	23.04
1.30– 2.30 "	1	271.8	27.2	146.3	49.2	0.88	29.12	19.0	8,968	951.0	8,036.0	29.56
9.20– 9.50 "	½	..	..	144.7	24.5	1.43	28.57	..	3,596	912.0	2,684.0	..

Exciting current is generated by two ten-by-twelve Chandler & Taylor engines, direct-connected to fifty-kilowatt, 125-volt

Westinghouse generators. One generator is sufficient to supply the necessary exciting current, the other being held in reserve.

The lower floor of the station pitches to a central point, where there is located a large sump-pump driven by a Worthington low-pressure fourteen-by-eighteen-by-ten-inch duplex pump.

All of the exhaust steam is caught in an exhaust head, the Holly gravity return system being used to catch all drips and return the water to the boilers.

For testing the efficiency of the turbines two platform scales containing two receiving-tanks have been placed in the basement. The piping in connection with same is so arranged that the water can be discharged from the hot-well pump into either of these tanks. When one of these tanks is filled with water and weighed, the water is discharged into a third tank, and thence pumped to the storage tank. Meanwhile water from the hot-well pump is being delivered also into the second receiving-tank, so that the water from the hot-well pump is always being delivered and weighed in the receiving-tanks over the scales. This system enables the engineer in a very simple manner to weigh exactly the steam consumption.

Two Westinghouse air pumps are installed, which keep supplied a compressed-air tank used for cleaning out the generators, and for general cleaning purposes, and to run an air-driven turbine for cleaning the boiler tubes.

The engine room is served by a twenty-five-ton Niles-Bement-Pond hand-driven traveling crane with a span of forty-six feet. There is also a small crane with a capacity of about five tons in the room containing the motors driving the centrifugal pumps for the condensing water.

The engine-room floor is finished in mosaic tile, the walls being finished in glazed tile with a brown faience trim. The room is well lighted, and there is everywhere plenty of room, allowing great freedom of movement in approaching the apparatus.

The switchboard is made up of thirteen panels of pink marble seven feet high. The panels run from left to right. Upon panel No. 1 are the switches controlling the induction motors for the centrifugal pumps. Each phase has its ammeter, and each circuit its separate integrating wattmeter.

Upon panel No. 2 is mounted the controlling apparatus for generator No. 1. There are an ampere-meter for each phase, a power-factor indicator, a wattmeter for each phase, and an ampere-meter for the exciter current. There are also a polyphase integrating wattmeter and field switch for the exciting generator, a main 2,400-volt oil switch, a synchronizing plug, and sockets for grouping the different voltages on each phase. A field rheostat switch is mounted on this panel, the rheostat being placed behind the switchboard, and the connecting leads brought in a loop through iron conduit under the floor to the switchboard. Panels No. 3, No. 4 and No. 5 are similar to panel No. 2.

Panel No. 6 is the exciter panel. On it are mounted two ammeters and one voltmeter for both machines. There are two field rheostats and two main switches. The exciters are compound-wound machines and run in parallel if desired.

Panels No. 7 and No. 8 are the load panels. These are fitted with ammeters, automatic oil circuit-breakers, and synchronizing lamps. The remaining panels are feed panels. Upon swinging brackets at the centre of, and just above, the switchboard are mounted a frequency meter, a voltmeter for the voltage on the line, and a synchronoscope.

Adjacent to the switchboard is located a telephone booth surmounted by a bank of incandescent lamps. Inside of the booth there is a monitor fitted up with plug and jack connections and visual signals, so that it is possible to secure telephonic communication not only with the city service, but with the several stations operated by the company. To call the operator's attention a gong is sounded and a lamp lighted. By the position of the lamp it is known immediately from what point the call emanates.

The leads pass from the generators underneath the floor to the switchboard, to oil circuit-breakers, to the bus-bars. From the bus-bars the circuits are led under the floor to a manhole outside of the building, and from the manhole to a temporary pole line. Ducts are now being laid to carry all of the circuits underground to the Pearl street station.

The connected load on the Hartford Electric Light Company's system at the present time is as follows: sixteen-candle-power incandescent lamp equivalent, 113,853; Nernst glowers, 3,763; Meridian lamps, 3,709; street arc lamps, 1,507; commercial arc lamps, 1,132; horse-power in motors, 5,302.

The officers of the company are: A. C. Dunham, president; S. G. Dunham, vice-president; C. C. Cook, secretary; D. N. Barney, treasurer; C. M. Yale, purchasing agent; R. W. Rollins, general manager; E. F. Lawton, superintendent; F. M. Wilbraham, chief engineer.

The Hartford Electric Light Company has always enjoyed a reputation for progressiveness which has placed it in the forefront in central station development. In the present equipment there are many innovations which will make for economy in central station practice, and the performance of this plant will undoubtedly be watched with great interest. The company was one of the pioneers in the adaptation of large-sized turbo-generating units, and it is the satisfactory performance of the initial 1,500-kilowatt machine which has prompted the use of this type of apparatus in the present enlargement. Under the efficient management of Mr. R. W. Rollins, the company is daily increasing the load on its system, and is making every effort to give the utmost satisfaction to all classes of customers. It is to Mr. Rollins and Chief Engineer Wilbraham that we are indebted for the data for this description.

Power at Niagara Rapids.

The Niagara river descends 100 feet and develops 2,500,000 horse-power between the base of the great cataract and the foot of the escarpment at Lewistown and Queenstown, five miles down stream. This energy, represented by the normal discharge of 222,000 cubic feet of water per second, is now expended in excavating the great gorge in which the White Horse rapids, the Whirlpool and Niagara glen are located. Fully eighty feet of this fall along the rapids occur between a point several hundred feet south of the cantilever bridge and another at the lower end of the glen, which can be connected by a tunnel some 10,000 feet long, on the New York side of the river. With the head of eighty feet and the discharge of 222,000 cubic feet per second named above these rapids thus develop 2,000,000 horse-power, as mechanical motion and heat. This power is fully one-half as great as that of the American and Horseshoe falls combined, since the volume of water is substantially the same in the falls and the rapids, and the descent of the former is only twice that of the latter. Making the fair assumption that sixty per cent of the gross energy of the water of these rapids can be transformed into electric current, the output of plants utilizing the entire flow would reach 1,200,000 horse-power. This capacity is nearly double that of the six great electric power stations that are now in various stages of completion about Niagara Falls, three on the New York and three on the Canadian side of the river.—*Architect and Builder.*

The Residual Electromotive Force of the Carbon Arc.

In a paper read recently before the American Physical Society, Mr. G. G. Becknell described a series of experiments made to determine the character of the electromotive force which has been observed to exist between the carbons of an electric arc immediately after the arc had been extinguished. It was found that if an arc be arranged so that it can be alternately connected to a source of supply and to a galvanometer, that a residual current will flow, after cutting off the source of supply for about ten seconds; that this current flows in such a direction as to show that the electromotive force existing between the two carbons is opposite to that of the dynamo. In order to show something of the qualitative nature of the phenomena, several methods were employed. In one a plate of copper or mica —that is to say, a plate of material either conducting or non-conducting—was interposed suddenly between the electrodes without touching either of them. This sufficed to arrest the residual current entirely, but upon removing the plate, the current was immediately reestablished. This seems to show that the residual effect can hardly be due to thermoelectric contact between the heated carbon tips and the heated gases of the arc, for in such a case the interposition of a copper plate across the arc would tend to increase the current through the galvanometer, and certainly would not stop it.

In another experiment a short copper wire joined to the positive and negative electrodes sufficed to stop entirely the residual current through the galvanometer. This shows that the effect can not be traced to a thermoelectric source existing outside the arc.

As a third test, a gentle blast of air was applied to the region between the carbons at the instant when the galvanometer was thrown into the circuit. This had the effect of removing nearly all traces of residual current as long as the air current was continued, but when the air blast was discontinued, the residual current was set up again, provided the air blast had not been applied for more than four or five seconds.

It was found that if the galvanometer was thrown off, and the dynamo thrown on to the air-gap for a few seconds, thus producing an electric field, but no arc, a smaller residual current was re-established in the same direction as before. This effect could be detected if tried within a minute or two after the interruption of the arc.

To study the phenomena quantitatively a rotating switch of special design was employed to break the dynamo circuit automatically at any desired instant, and then, after a definite and measurable interval, which might be varied at will, to throw the galvanometer into circuit with the cooling arc-gap for a definite, fixed period, which might also be varied as desired. As soon as this apparatus was employed it was observed that the length of time the arc is allowed to burn before measuring the residual electromotive force is an important factor. It seems to require about one minute to reach a steady state. The arc was used in a vertical position, which was found to give more uniform results. It was found also that the magnitude of the residual current is somewhat dependent upon the quality of carbons used. Graphite terminals produce very small residual currents. By the use of the switch alluded to, curves were obtained showing the rise and fall of this counter-electromotive force and of the residual current as the electrodes cooled. The current characteristic falls off more rapidly than the corresponding curve for the electromotive force. This shows that the resistance of the arc-gap increases rapidly with cooling. If the relation between the residual electromotive force and current and resistance be that expressed in Ohm's law, the data obtained show that the gap itself has a negative resistance. There is therefore some other factor to be accounted for. To explain this residual current it is suggested by the author that it is due to the diffusion of ions which are given off by the incandescent carbon. As long as the arc is in operation, the negative ions emitted in far greater numbers from the incandescent tip of the positive carbon than from that of the negative carbon are not borne across the gap against the electric field but are driven back into the positive terminal from which they proceed; but when the arc is interrupted, the conditions are changed. There is then no longer an impressed electric field to hold back the stream of ions. They are freely emitted from both incandescent terminals, yet more abundantly from the positive, and they diffuse across the arc-gap, giving rise to the residual current. This action continues until the carbons have cooled down to a point where the production of the negative ions by the positive carbon is no longer in excess of the rate of their production by the negative carbon. The fact that graphite terminals give a small residual effect may be due to the fact that graphite is a fairly good conductor of heat, and would thus tend to equalize the temperature of the electrodes more rapidly than ordinary carbon.

Line Troubles.

In a paper read before the recent meeting of the International Association of Municipal Electricians, Louis Gascoigne, of Detroit, Mich., pointed out some of the line troubles in the municipal plant at Detroit, and suggested remedies, as follows:

The telephone lines were easily cleared from the electromagnetic induction, but a change in the electrostatic capacity of any circuit would alter the conditions entirely. The alteration of the electrostatic induction is produced in three ways: first, by the leakage of both the arc and telephone circuits, due principally to dampness; secondly, by varying resistances, particularly in the arc circuit; thirdly, by the disturbance due to independent parallel lines. The arc circuits, when running, will vary in insulation from 500 to 150,000 ohms between wires and ground, yet on battery test the next day will measure over a megohm. I am satisfied from tests conducted so far that the increased induction caused by this variation can be eliminated by the proper use of condensers and inductances. The second variation, that due to a variation of the resistance of the arc circuit, is entirely a lamp variation and will be corrected in the lamp.

The third disturbance, that due to independent parallel lines, is the most serious one to overcome. By independent parallel lines, I mean any wire paralleling an arc circuit and constituting in itself a closed circuit. My attention was first called to this about three years ago. The arc circuits are grounded at the switchboard during the daytime, so constituting a closed circuit grounded at one point. If the circuit parallels an alternating line, it becomes the secondary of a transformer. In testing this circuit during the day, the ground would be taken off and the circuit opened at the switchboard. While measuring to ground I would frequently get a spark at the jack which could not be attributed to the testing battery. I have sent patrolmen out to find an imaginary cross with live wires, but two or three fruitless searches led me to realize the cause. A fire-alarm wire, a police telephone line and an arc circuit are on the same cross-arm for a short distance, the fire-alarm wire finally leaves the commission's poles, and later is carried for some distance on police poles, thus paralleling a telephone line which also parallels the same or another arc circuit. Ordinarily, the fire-alarm wire is a closed low resistance circuit and so acts as the secondary of a transformer of which the arc wire is the primary, and this secondary current induces a tertiary one in the telephone wire which is out of phase with the secondary current induced by the arc current in the same line. This may be obviated by neutralizing the current in the fire-alarm wire, although probably the easiest way is a new line of poles.

LINE CONSTRUCTION.[1]

BY B. L. CHASE.

The first consideration in building a pole line is the question of location—as a rule, a difficult proposition in itself, for in most cities so many corporations maintain overhead lines as to make it a nice question, from an operative and commercial standpoint, which route could best serve the territory in view.

The probable opposition of property owners also must be considered, and overcome, as this sometimes causes much delay and financial loss. Direct lines are, of course, the best, but are not always practicable, for in city construction many obstacles must be surmounted such as the lines of competing companies, telegraph, telephone and fire-alarm lines, trees, and instances where high-voltage lines might come too close to buildings and endanger life. All of these conditions must be considered in the location and constructional features.

In laying out a line the poles should be located on lot lines, where possible. The future should also be taken into account—poles should be located on the corners of intersecting streets, as such placing will simplify and cheapen the construction of lines on these cross streets, when such are necessary.

In order to secure freedom from interruption, high-tension lines should be constructed, above all telephone, telegraph and other wires for service of a similar character, for these conductors being small, and easily broken down by wind or sleet, will cause unending trouble to both companies, and be a constant menace to life and property.

High-voltage lines constructed underneath telephone, telegraph and other wires also endanger the lives of the employés of these companies, whose work necessitates their constant exposure to danger, by climbing between high-tension wires. Telephone linemen do not, as a rule, realize the importance of keeping entirely clear of the high-voltage circuits, as their work is such, that all wires may be handled without personal discomfort.

A good road along a pole line is very desirable, and the route selected should be as free from obstruction as possible, and trees carefully trimmed, as even the small limbs will be the cause of much trouble.

Wood poles are the most desirable for high-voltage transmission, iron poles affording more chance for troublesome and dangerous grounds, and subjecting workmen to extreme danger from the same cause. Iron poles, however, have demonstrated their utility for low voltage and railway work, and are more sightly in such cases where it becomes necessary to place them at close intervals.

Michigan and Idaho cedar poles are most commonly used in this state, Idaho largely taking the place of Michigan cedar in long poles, owing to the difficulty of obtaining Michigan poles which come within specifications. The Idaho cedar poles are generally straight and smooth, and often of nearly the same size from end to end, and less opposition is met from property owners when such are used. Michigan poles generally have large butts and crooks, a feature most objectionable to some property owners, who would be perfectly satisfied if a nice straight pole had been set. All poles should be shaved, painted and gained before being erected, as the cost of labor in doing this work will be double after the pole is set on end.

For ordinary work poles should be set 120 feet apart or forty-four to the mile, but local conditions will govern, especially in cities. The setting should be carefully done, and the poles kept as nearly in line as possible. Too much care can not be taken in tamping, as a poorly tamped pole will be out of line after the first wind storm, and to straighten up means unnecessary expense, and if left in that condition speaks but ill of the man who had charge of the work.

Hard yellow pine serves best for cross-arms, and for ordinary construction will give good results, but for heavy corners and junction poles where the strain is great, oak arms should be used. Machine bolts five-eighths or three-quarters inch in diameter passing through both arm and pole with a large washer under both head and nut, will be found the best for holding the arm securely in the gain. This method makes a cleaner and safer job than fastening the arm with lag-screws, and permits repairs and changes to be made much easier. Lag-screws are cheaper, however, and are sometimes used in ordinary construction, but should be avoided in heavy work.

For high-tension lines the cross-arms should all be double, and a block securely bolted between the arms about eight inches from the end will materially add to their strength. The initial cost of this mode of construction will be somewhat higher, but will be cheaper in the long run. It practically prevents a wire from coming in contact with the arm through breakage of a pin or insulator.

Poles at angles should always be guyed at a point as near in line with the strain as possible. A very light pole properly guyed will withstand heavy strains, without distress, which would otherwise require the erection of a heavier pole.

In all cases great care should be exercised to keep guys clear of all other wires, and strain insulators should be cut in about six feet from the pole, which will assure a greater degree of safety to employés who work among the high-tension wires and the guy wires with which they might come in contact accidentally. Guying to trees is a bad practice.

The most dangerous strains on overhead lines come from sleet storms, ice sometimes covering the wires to a depth of an inch. Under these conditions the insulators and pins become the weakest points, and precaution should be taken in your construction to guard against such strains. A three-eighths-inch carriage bolt through the pin lengthwise will ensure against a failure under almost any conditions, and will be found to be a cheap method of reenforcement. Other means for the prevention of accidents should be installed, such as iron-guard wires at angles to keep the wires from slipping off the arm, should a pin or insulator break.

Several head guys at corners or at the end of the line will relieve the strain and will in case of accident to these poles save several poles from being broken.

It is the belief of the writer that only in a case of emergency, work should be done on circuits of this nature while current is on the line, for it is extremely hazardous at best, and the method to be preferred is to complete all arrangements and cut the current off only long enough to make actual connections.

The different circuits should be so arranged that sections can be cut out by means of oil switches on poles, so that in no case would it be necessary to deprive a large number of customers of current. This system has proved very satisfactory, as it is comparatively seldom that the current is cut off, and an explanation of the danger incurred by the linemen is generally satisfactory to any user of current who makes complaint. It is customary to do such work at a time when it will least interfere with the larger number of users of current, and only after notifying them, and considering their suggestions as to time.

A word might be said in regard to lightning arresters. These are generally placed at intervals of about a mile, and seem to afford protection to transformers, as it is but seldom that one is damaged. It is different with the arresters themselves, however, as several of these are lost in every storm. Many different types are in use, with but slight variation in the results.

The line proposition resolves itself down to a careful study of all contingencies: the installation, of good material, thorough workmanship, rigid inspection and proper maintenance of every detail, as it is only by constant attention to these that the required service may be obtained.

[1] Abstract of paper read at the recent convention of the Ohio Electric Light Association, Put-in-Bay, Ohio, August 16, 17, 18.

The Development of the Postal Telegraph-Cable Company.

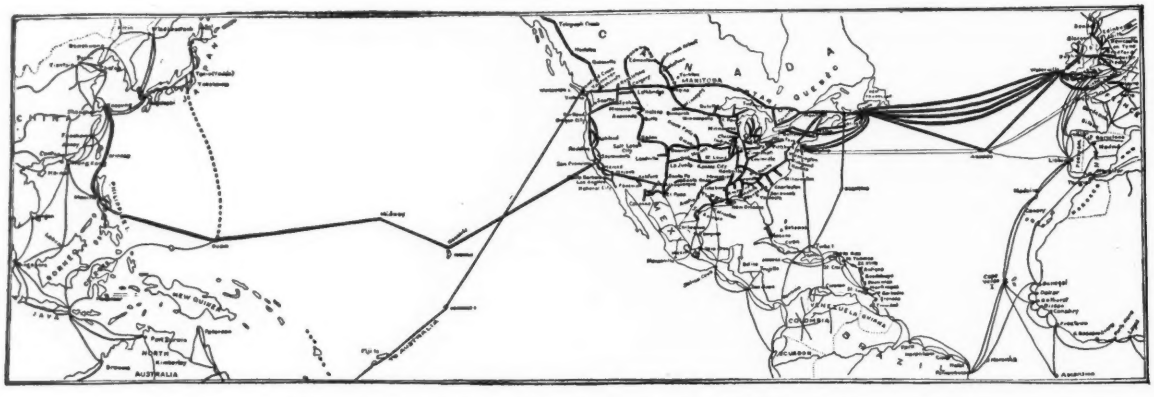
By Charles P. Bruch, Assistant General Manager.

IN ANSWER to an enquiry concerning what features of service most appeal to the consumer and create good will toward the supplying corporation, I think three words will answer the question: "accuracy, promptness, courtesy." Accuracy and promptness are the ideals that this company is striving to attain. To describe in detail the methods adopted to this end would require more time than I am able to give and, I think, more space than you are able to give to the subject.

Such progress as we may have made toward the realization of our ideals is probably explained by a statement of the facts that this company's management determined from the first to establish permanent business, based on sound principles and businesslike methods, and have steadfastly adhered to that policy; that the company's employés are intelligent, diligent, energetic and enthusiastic; that they are in sympathy with their employers and are working for the company's interests, recognizing that their interests are identical with the company's interests and that unless the Postal service is the best public patronage can not be retained, and that every man in the service is proud of the company's success. We believe that these are the reasons why the Postal company has been successful in the past and they are the reasons why we hope that it will be successful in the future.

Early in the year 1881, the Western Union Telegraph Company, under the leadership of Mr. Jay Gould, acquired control of all the commercial telegraph lines in the United States and Canada, and before the end of that year had combined the Western Union cables with the several other cable companies in a pooling agreement, thus forming a complete monopoly of the telegraph business of this continent, and across the Atlantic ocean. The smaller companies that had previously been built up inevitably proved unprofitable, and impossible of permanent maintenance, every one of them having been founded upon mistaken notions of the telegraph business under various so-called improvements in methods of transmission, reduced rates, rebates and other forms of bidding for business, which soon proved to be ruinous; or upon a speculative plan not designed to be permanent but to do the most harm in the shortest time, for the purpose of being "bought off." The most available routes for the construction of telegraph lines between principal points had been fully occupied, rights of way had become very difficult and expensive to obtain; the telephone was just beginning to assume other than local importance, and by many people was already deemed such a strong competitor for the transmission of intelligence as to seriously threaten at least the growth of the telegraph.

Under such circumstances it was a common belief on the part of the public, and also of many of the best informed telegraph managers and employés, that competition in this business was at an end; that no capital would be found to undertake the building of new lines, and that no telegraph officers having the necessary experience and ability to conduct the business successfully would hazard their reputation by entering upon so hopeless an enterprise. But the demand for competition between principal points, the growing requirements of large business houses for private wires, and the disposition to exploit new systems of transmission, together with the speculative element which seems always on the alert to make something to sell, resulted in building up within the three subsequent years a more extensive, diverse and damaging competition than had ever before existed. The "Mutual Union," the "American Rapid," the "Bankers and Merchants," the "Baltimore & Ohio," the "Southern," the "Board of Trade," the "Pacific Mutual," and the original "Postal" were among the most extensive and important of the corporations that were formed, and all were competing with each other, as well as with the Western Union company, in the most wasteful manner. The original "prospectus" of the Postal company, setting forth expectations of vast profits from small expenditures through the use of compound steel and copper wires, automatic and multiple systems of transmission, a very low rate, made uniform, regardless of distance; business relations with the post-office department of the government and other extravagant and Utopian theories, leads one to wonder that such intelligent men as its original promoters were could have been so sanguine of the success of their scheme.



LINES AND CABLES OF THE POSTAL TELEGRAPH-CABLE COMPANY.

In this almost chaotic condition of the affairs of the telegraph, Mr. John W. Mackay came into control of the property bearing the "Postal" name. He was without knowledge of the details of the telegraph business, but with broad conception of its usefulness, and firm faith in its growth, he determined to establish a business on a permanent basis, and under methods protective alike to the patrons of the telegraph and those who invested their money in maintaining and increasing its

usefulness. With this purpose in view from the first, he brought into his service men of large experience in both telegraph and cable business, of known industry, integrity, and sound and conservative judgment, and to them he left the development of the business, and the means of escape from the then prevailing chaos, almost as completely as if they had themselves been the owners of the properties.

Possessed of ample resources and unlimited patience, he brought about the laying of new and superior cables across the Atlantic ocean, the reorganization of the Postal company upon a greatly reduced basis of capitalization and free from bonded debt, the adoption of practical and businesslike methods, the just and considerate treatment of the public in all its varied interests, the cordial and friendly relations between employer and employé, and the result is before us today in the establishment upon a firm and financial foundation of the "Postal Telegraph-Cable Company," having a land-line system many times greater than all previous competitors of the Western Union company, built and equipped in the most substantial and "up-to-date" manner, and with cables not only connecting with Europe, but across the vast Pacific ocean.

To Mr. Mackay, primarily, and to those so effectively associated with him, in part, the American people are indebted for rates of telegraphic transmission as low as it is possible to afford in view of the great cost of constructing, maintaining and operating substantial lines.

The Postal company was organized in 1886, two years after the Commercial Cable Company. The growth of the Postal has been as rapid as that of the cable company, as stated below. The Postal company started by taking over a number of small telegraph lines, the majority of which were bankrupt. The properties in the United States owned and controlled by the company represent an investment aggregating over $25,000,000.

The pole mileage of the Postal system is now 49,012 miles of land lines, the wire mileage is 281,715 miles, and the points reached are 20,341. Of the points reached, 1,782 in 1903 were reached by no other telegraph company. Nearly 4,000 new offices were added last year. The number of messages handled by the Postal in 1903 was 21,600,577.

The growth of the Commercial Cable Company has been both rapid and continuous. It was found necessary in 1894 to lay a third cable between New York and London. In 1900 a fourth was laid.

The business of the company continued to increase and it also took over the operation of the American end of the German Atlantic Cable Company's lines. The Commercial Cable Company therefore operates no less than five cables across the Atlantic Ocean. These give the company direct lines to London, Paris and Germany.

In 1901 the Commercial Pacific Cable Company was organized for the purpose of laying and operating a cable from San Francisco to the Hawaiian Islands, Midway, Guam, the Philippine Islands and China. This cable, which is nearly 8,000 nautical miles in length, has been completed at a cost of about $12,000,000, without asking any subsidy from the government. It is believed that the cable line will be extended to Japan in the near future.

There are about 232,000 miles of submarine cables in the world. Of this the "Postal Telegraph-Commercial Cable System" controls about 27,000 miles, or more than one-ninth of the total, and about 281,000 miles of telegraph line.

In addition to the above the Postal Telegraph system has direct communication *via* the Canadian Pacific Railroad telegraphs with the British Pacific Australian Cable.

The Commercial Pacific Cable Company, whose cables extend from San Francisco *via* Hawaiian Islands, Midway Islands, and Guam to the Philippines, connects at San Francisco with the lines of the Postal Telegraph company, and at Manila with those of the Eastern Extension company, and thus furnishes the most direct route to the Philippines, Hong Kong, China, Japan, Corea, and Formosa.

This company has its own offices in London, Liverpool, Manchester, Glasgow, Bradford, Leith, Dundee, Newcastle-on-Tyne, Edinburgh, Bristol, and Weston-Super-Mare; all of which are in direct communication with the cable stations by special wires operated by its own staff.

The Commercial Cable Company's connection with the German Atlantic company provides also facilities for the handling of German traffic.

The German company has, at present, one, and is now engaged in laying a second, cable direct from New York to Germany *via* the Azores. The American end of this German system is operated by the Commercial Cable Company from its New York office, whence messages are sent direct to and received direct from Germany *via* the Azores. In Europe the German cables land at Emden and terminate in the office, in that city, of the German telegraph administration, whence special wires are operated to all points in Germany and Holland.

At the Azores Islands the Commercial Cable Company connects and occupies a joint office with the Eastern Telegraph Company, at which messages to and from Mediterranean ports, all parts of Africa and the east coast of South America are transferred.

The Commercial company's traffic to and from Norway, Sweden, Denmark and Russia is by direct special wire transferred to and received from the lines of the Great Northern Telegraph Company at London.

The Commercial company's traffic to and from France and central Europe transits direct over the Commercial company's submarine cable to Havre and by underground cables to Paris.

The Halifax & Bermudas Cable Company and the Direct West India Cable Company occupy a joint office with the Commercial Cable Company at Halifax, Nova Scotia, and thus provide the most direct route and efficient service to the Bermudas, Jamaica and the Windward Islands.

The Commercial cables are equipped with the latest and most efficient apparatus, in which the company's electricians are constantly making improvements. All are duplexed and their carrying capacity thus doubled. It has also introduced on its cables a new system of automatic repeaters, whereby one cable may be electrically coupled to another and retransmission thus dispensed with. The introduction of this system enables the Commercial to work direct from New York city to Waterville, its cable station in Ireland.

The telegraphs in Europe, Asia, Australia and South America are administered by the governments of the respective countries which comprise these geological divisions of the world, and their operation is governed by a code of international telegraph rules and regulations to which the foreign government administrations rigidly adhere. All the cable companies are compelled to transfer to government administrations messages for points at which they have not offices of their own. The messages so transferred are subject to these international rules and regulations.

Reviews of Current Engineering and Scientific Literature.

Commercial Training for Engineers.

What is thought to be a desirable method of training the English engineer is here discussed by Mr. R. D. Summerville. The bulk of engineering—that is to say, the business of making all kinds of materials and machinery—is a commercial pursuit. Manufacturing establishments are run solely to make a profit, and in nine cases out of ten the men in charge of paying works are business men rather than engineers. It is rare to find a paying establishment managed by a highly trained engineer. The reason for this is thought to be the lack of commercial training of the engineer. He should not only learn the methods of the shop and the draughting room, but he should learn business methods, bookkeeping, shipping methods, etc. The training which prevails at present in England consists in taking the young man from school at the age of sixteen or seventeen, and putting him as a pupil in some factory. He is passed through the various departments of the works, and then goes to the draughting room. After three or four years he has learned shop methods, but he is not qualified to take a manager's position because he knows nothing of business methods. It is thought that to save time which would be lost in learning these, the engineering student should attend a business school while he is going through the shops. He should also attend an engineering school in the evening. Such a course, followed for four years, would give a man all the necessary information in regard to shop methods. He should then be put at commercial clerical work for a year, from which he should be passed into the estimating department for two years, so that at the age of twenty-five he should be an engineer with an excellent technical and commercial training. This course would not only weed out the incompetent or unambitious students, but would turn aside those to whom the scientific appeals more strongly than the practical. The latter class would develop into experts, and thus find good positions, but they do not make good business managers.—*Abstracted from Engineering (London), August* 18.

General Rational and Real Dimensions of Magnetic and Electric Quantities.

M. L. G. Muaux discusses here a system of general rational dimensions for electric and magnetic quantities. Starting from the two laws of Coulomb, which give the force in terms of electric quantity or magnetic strength, and distance; and the law of Biot and Savart, which states the relation between electric current flow and magnetic action, it is shown that an attempt to simplify the expressions by adopting such a system as will make the constants usually inserted in the formulæ unity, really complicates the situation. These constants have a physical character, and the assumption that they are merely numerals leads to difficulties. To derive a satisfactory general system of dimensions, it is assumed first that magnetic strength and electrical quantity are functions of the three fundamental quantities of length, mass and time. They are then so expressed, the exponents of course being different for the two quantities. Using these assumptions, the author works out a table of dimensions expressed algebraically. For such expressions to have any value they must not only be correct analytically, but they must agree with known physical characteristics. This can be obtained by assuming certain relations to hold between the exponents of the electric and magnetic expressions. A relation is found which reduces the expressions so that they agree with well-known mechanical analogies, and at the same time puts them into simple forms. These reduced expressions are given. It is pointed out that they not only agree with known phenomena, but they avoid the confusion which results from other suggested systems. It is held by the author that this system is not only general, but it is rational and real, and attributes to each quantity a real part, which is confirmed by experience. This system should be useful in interpreting theories, particularly those which take advantage of mechanical analogies; and it can be extended to other physical phenomena.—*Translated and abstracted from L'Éclairage Électrique (Paris), August* 19.

The Effect of Radium on the Strength of Thread.

Some time ago Lord Blythswood announced his observation of the destructive action exerted on cambric by the radiation from radium. This effect has been studied by Miss Hilda P. Martin and Mr. W. B. Morton, who have investigated the progressive decrease of strength of threads when exposed to radium bromide. Ten pieces of thread were exposed at a time. These were folded around a strip of writing-paper laid on the top of a capsule containing the radium, so that the threads were exposed to the bare radium at a distance of about half a centimetre. After definite periods of exposure the average breaking strength of the threads was taken. The points obtained lay closely on a smoothly descending curve. In case of silk fibres the loss of strength goes on at a practically uniform rate from the beginning up to the longest duration of exposure (seven days). The initial strength of the thread was seventy-eight grammes, and this decreased by about four grammes per day. The cotton threads gave a curve which falls more rapidly in the earlier than in the later stages. At the beginning the strength was 370 grammes, and decreased at first about sixty grammes per day. After ten days the rate of weakening was about thirty grammes. The longest exposure was seventeen days, at which time the strength was reduced to fifty grammes. The loss of strength seems to be due entirely to the α rays. When a piece of paper was interposed between the threads and the radium there was no loss of strength. In one experiment the threads were maintained moist by allowing the ends to dip in water. On inspection it was found that the radium bromide, being hygroscopic, was wet and partially dissolved, and, upon testing the threads, the strength was found to be higher than when exposed in a dry condition for the same time. The difference was too great to be attributed to the increase of strength imparted to the threads by moisture. It was due to the decreased emission of rays accompanying the solution. The recovery of activity of the dried radium was traced by exposing threads to it. The effectiveness of the radiation, as measured by the weakening of the threads, came back by regular steps in about a fortnight to a point slightly greater than the original.—*Abstracted from Nature (London), August* 27.

The Variation of a Capacity with Temperature.

The sensibility of the alternating-current galvanometer has made possible the measurement of small changes of capacity due to changes in temperature. This instrument is of the D'Arsonval type, ex-

cept that the field is built up of laminations of soft iron, and wound so as to be excited by an alternating current. In the particular instrument used in these measurements by Mr. Earle M. Terry, the laminations are circular discs about thirty centimetres in diameter, built up so as to have a cross-section about four centimetres square. An opening of about 1.5 centimetres wide was made to admit the coil, the pole-faces being tapered down to about one centimetre in width. The coil is made up of No. 40 double-insulated wire wound on a wooden form, and has a resistance of about 350 ohms and an inductance of fifty milli-henries. In comparing capacities the bridge method was employed. The two capacities were subdivided condensers having a range of from 0.05 to one microfarad. Both capacities were placed in tin boxes immersed in large water baths. The water of the baths was kept constantly stirred. Owing to the large thermal capacity of the condensers, it took usually about forty-eight hours for them to come to a uniform temperature throughout. The apparatus allowed a precision of about one in 20,000, or 0.005 per cent, to be obtained, and for any particular setting a change of one part in 100,000 could be detected easily. The capacities at different temperatures were measured, and the temperature coefficients determined. For the three condensers used the coefficient varied from 0.00028 to 0.00013. The capacities, as measured at different temperatures, give characteristic curves reasonably close to straight lines, with the exception of the condenser showing the lowest temperature coefficient, and this one leaked slightly. It is concluded that a condenser has a temperature coefficient depending in value upon the construction; that it is negative and of sufficient magnitude to require consideration when used in measurements of high precision.—*Abstracted from the Physical Review (Lancaster), September.*

The Value of Canals and What to Do with Them.

There is here presented a critical study of the situation in regard to the English canal systems. The blame for their present more or less abandoned condition has been attributed to the action of parliament in permitting the railways first to control and subsequently to starve all canals competing with them; but the history of canal enterprise in Great Britain does not bear out this charge, for between 1849 and 1850 parliament was compelled either to purchase the canals on behalf of the government or to allow the railroads to acquire them. The latter course was followed, but it was provided that the roads should maintain the canals and keep them open. It is held that this policy saved the canal system as a whole from becoming absolutely derelict. The total length of the canals in England and Wales in 1830 was 4,332 miles. Three-fifths of these were canals proper, and two-fifths river navigations. In 1898 the mileage had been reduced to 3,132, five-sixths of this being canals, and one-sixth river navigations, a diminution of nine and one-quarter per cent on the canals, and fifty-eight and one-quarter per cent on the river navigations. Of the total loss of mileage which has occurred inland, only 116 is directly traceable to railways, this being that of canals filled up and converted into railways. The remainder of the loss in canals proper and river navigations is due simply to abandonment—a fate which would have overtaken the canals even had they not been handed over to the railway companies. In 1898, in Great Britain the independent canals represented a little over seventy per cent of the total length, sixty-eight per cent of the total cost, carried eighty-four per cent of the total traffic, earned eighty-two per cent of the total revenue, expended seventy-eight per cent of the total expenditure, and received sixty-four per cent of the total earnings; but only sixty-seven per cent of these independent canals paid working expenses, while of the railway-controlled canals sixty-three per cent paid working expenses. The traffic per ton-mile on the independent canals amounted to 11,400 tons, as against 5,277 tons on the controlled canals. The general average for both was 9,594 tons per ton-mile, while on the railways, when reduced to the equivalent single-track length, the tonnage per ton-mile in the same year was only 11,000. These figures testify to the merits of water carriage for certain classes of inland traffic, even when exposed to the full force of competition and neglect. It is thought that if the railways, which have excellent organizations, would change their traditional policy and transfer as much of their slow freight traffic to the canals under their control as would bring up the traffic on these canals to the figure of the independent canals, they would earn enough to pay four per cent at least on their capital stock. At the same time they would probably relieve 1,200 miles of railroad of more or less congested traffic, or postpone for at least a generation the costly alternative of doubling these lines. There is no essential reason why these controlled canals, even without improvement, should not carry double and treble the amount transported by the free canals, with the best financial results. As supporting this view, the example of the Aire & Calder canal system is quoted, which, owing to its efficient management and the system of dealing with traffic by barge trains, has held its own against the most strenuous railway competition, and which carries, on an average, three times the tonnage per ton-mile carried by the canal system. Competition shows that on this basis the independent and controlled canals could handle over 71,000,000 tons of freight annually, and relieve the railways of twenty-six per cent of their present freight traffic. The inducements to the railways to utilize water carriage are as follows: unavoidable payment of interest on the cost of the controlled canals; unavoidable maintenance of canals; possibility of getting rid of any desirable portion of their most obstructive freight; the possibility of effecting all this without any serious increase in their working staff; the possibility of trebling the margin of profit involved in carrying a ton of freight one mile. It is held that there is but little hope of improving the canal situation by government ownership. The only outlook is the organization of an adequate system of management. The best solution would be to have the railways reverse their policy and utilize the canals to the fullest extent. If the latter can not be done, the different systems should be thoroughly organized and traffic exchanges be arranged, and an energetic policy for securing freight be adopted. If such a course were followed by the independent canals, it is probable that the railways would be forced to adopt similar methods for those controlled by them. In any case, improved methods of haulage would be necessary.—*Abstracted from the Electrical Review (London), August* 18.

Ventilating Arrangements of Electric Generators and Motors.

An interesting patent was taken out recently in England by Siemens Brothers & Company, which embodies a new system of ventilating electrical apparatus. The custom which most generally prevails to-day is to make use of the revolving part of dynamos and motors to set up a current of air, both through itself and through the stationary part. In this way ventilation is secured. The same method of circulating the air is employed in the new design, but this air is supplied to the machine through ducts contained in the housing, to which air is conducted from the outside. In this way cool air is supplied to the machine in place of the usually warm air of the generating room, and a more efficient cooling action is obtained.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Type of Arc Lamp.

During the last few years the tendency toward the use of the enclosed arc lamp for commercial lighting has been so marked that in many cases lamps of older types have been discarded in favor of the newer systems. It is largely due to the great improvements that have been made in the construction of this type of lamp that these systems have been able to hold their position as superior to all others.

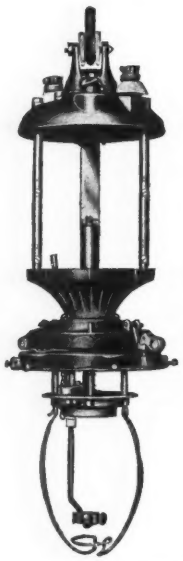


FIG. 1.—FRAME OF LAMP, WITH MECHANISM REMOVED.

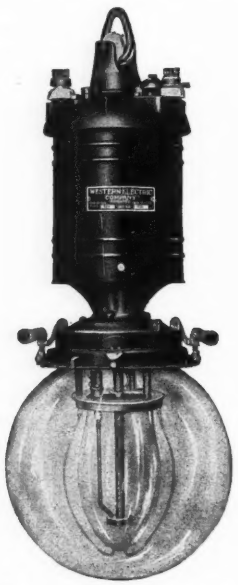


FIG. 2.—LAMP COMPLETE.

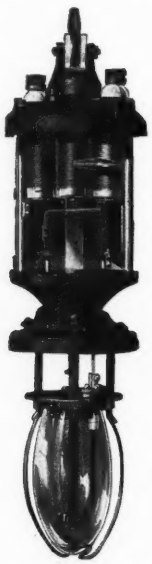


FIG. 3.—LAMP WITH CASE AND OUTER GLOBE REMOVED.

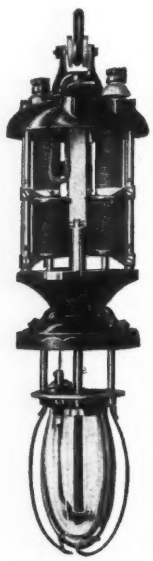


FIG. 4. - SHOWING DASH-POT.

Simplicity and rigid mechanical construction are admittedly the essential requirements for the successful arc lamp. The frame of the lamp should be so designed as to give a maximum rigidity without excessive weight, and should be sufficiently rigid to permit of shipment without endangering the adjustment. No amount of care in the adjustment of a lamp is of any avail if the frame is not such as to maintain the adjustment. The lamp should be supplied with every device necessary to successful operation, but each part should be as simple and indestructible as possible and at the same time well protected from the weather and easily accessible. The accessibility depends partially on the case and partially on the internal arrangement. A solid case which offers perfect protection and which may be easily removed is desirable. The lamp should be so arranged that any one part may be removed without disturbing any other part.

FIG. 5.—SPECIAL PORCELAIN LAMP INSULATORS.

As an illustration of the practicability of designing a lamp with these features, illustrations are shown of a lamp manufactured by the Western Electric Company, Chicago, Ill., which carries out simplicity and rigidity of mechanical construction and at the same time has all of the accessories tending to increase the general efficiency of the lamp.

In Fig. 1 is shown the frame of the lamp with all mechanism removed. It will be noted that the upper and lower castings are held together by means of two brass posts rather than by the single tube used in many types. From these two posts all working parts are hung. This type of construction is particularly rigid in proportion to the total weight. It is upon this rigidity that the permanency of the alignment and the adjustment of the various parts depend. The frame has been standardized and is used for lamps of all types. A lamp for one service may be easily converted for another service by

FIG. 6.—SQUARE TUBE OR GUIDE FOR UPPER CARBON HOLDER.

the change of only such parts as are special to each type.

In Fig. 2 is shown the lamp complete and ready for service, while Fig. 3 illustrates the lamp after removing the case and outer globe. Before the case is lowered, it is necessary to remove the outer

FIG. 7.—GAS CHECK PLATE AND BAIL SUPPORT.

globe which may be done by turning the supporting lugs to a vertical position. When in a horizontal position, however, the globe is locked in place, preventing any swinging or vibration. The case is held by three screws which may be easily loosed, but at the same time they can not be entirely removed as the ends are burred after assembly. This construction provides a solid case, easily removable, permitting perfect access to all parts and offering a very certain protection.

Space does not permit a full recital of all the details of this lamp. Only a few of the particularly interesting features will, therefore, be covered. It is the gen-

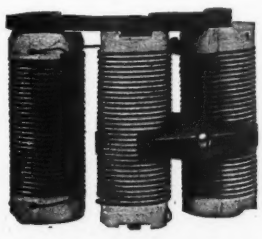


FIG. 8.—RHEOSTAT USED IN BALLASTING THE ARC.

eral opinion that almost any kind of regulating magnet having sufficient power to lift the upper carbon and establish the arc is all that is required; a little experience in the operation of lamps will show that too much care can not be taken in the design of this part. In the Western Electric lamp the regulating magnet coils have a very long range of action with a slightly rising characteristic as the core descends. This is done to prevent the frequent dipping and extinguishing of the arc which is sometimes apparent, the lamp operating at times for periods of longer than three hours without dipping.

In Fig. 4 is shown the dash-pot, which is of special form, designed with particular reference to the requirements. It acts only while moving in the direction to establish the arc, being permitted to move freely in the reverse direction by a simple valve mechanism. This valve is positively operated by the action of the regulating magnet, no dependence being placed on springs or gravity devices. When the lamp is not in operation the piston of the dash-pot occupies a position at the top of the cylinder. Any upward movement of the cylinder produces a partial vacuum tending to retard the movement. This is very important in order to prevent too abrupt separation of the carbons, and to enable the lamp to start cold without the disagreeable dipping and pounding so often observed. While the dash-pot may be easily cleaned, it is not subject to interference by ordinary accumulation of dust or moisture and is found to add greatly to the sensitiveness of action and to the natural regulation to the pump as a whole.

Fig. 5 illustrates the special porcelain insulators used in mounting the lamp terminals upon the cap and the switch mechanism within the cap. The terminal insulators outside the cap have large drooping flanges which serve as watersheds and prevent leakage between the terminals and cap. The terminal insulators used within the cap are of generous proportions and so formed that they act in conjunction with the squared shanks of the terminals to prevent rotation of the terminals. The switch insulator is of such design that it serves the double purpose of insulating the switch lever from the cap and as a mechanical support for same. This avoids the use of mica washers or small lava bushings which have so frequently proved a source of trouble.

Fig. 6 shows the square tube or guide for the upper carbon holder and a protecting casing for the folded copper ribbon used for connecting the tube and carbon holder. This device has proven thoroughly reliable as a means of preserving positive electrical connection and has the advantage of complete protection from outside interference.

The gas check-plate and method of support are shown in Fig. 1, Fig. 3 and Fig. 7. This plate is of composite construction, the main plate against which the globe finds its seat is of hard bronze which is found to resist the corroding action of the gases within the globe and thus maintain a perfect joint even after long use. The lower portion of the gas check-plate is of iron. It operates to control the admission of air to the globe, admitting only the amount necessary to secure the maximum lighting effect with minimum carbon consumption.

In Fig. 8 is shown the rheostat used in ballasting the arc. This rheostat is made up of a number of porcelain drums or cylinders having shallow helical grooves on their surfaces in which the resistance wire is wound, the ends of the wire being secured by passing through holes at the ends of the cylinders. The cylinders are mounted vertically in the lamp and are so held that perfectly free play is given for expansion or contraction. When current is turned on the heat of the resistance wire gradually extends to the porcelain cylinders, but as this expansion is principally in the direction of the length of the cylinders no inequalities of expansion result which could bring breaking strains. A sliding contact device is provided by which adjustment of the amount of resistance can be readily made. In this system of resistance cylinders lies an important element of safety, as it will readily carry all excessive currents which are liable to be set up by short-circuiting of the arc or other cause and thus overcome a long standing source of trouble in the operation of constant-potential arc lamps.

The regulating magnets can, when desired, be wound with wire of special insulating properties, enabling the coils to withstand the heating effects above described, making the lamp practically indestructible even on continuous short-circuit.

The lamps are made in types suitable for use on circuits of 110 or 220 volts, direct current. Metal or opal glass shades, alabaster or clear outer globes can be used according to the particular class of lighting service to be given.

Northern Elevator Motors.

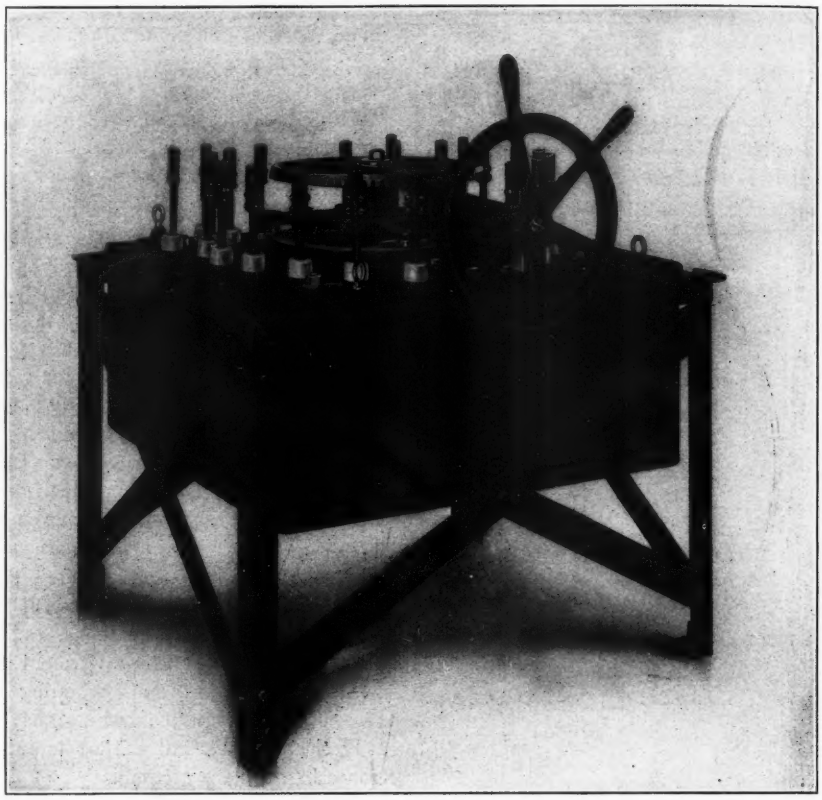
The growing requirements of modern structural engineering for electric elevator motors bring to the Northern Electrical Manufacturing Company, Madison, Wis., increased demands for elevator-motor equipments. The Northern elevator-motor line includes standard electric motors, with special low frame, square type elevator motors, etc. The spherical type is built for both direct-connection or direct-coupling to the elevator engine or for belted drive. The square type is designed for direct-connection to high-speed passenger elevators. The characteristic of the square type elevator motor is the rapid acceleration provided and the powerful starter torque.

A Large Static Transformer.

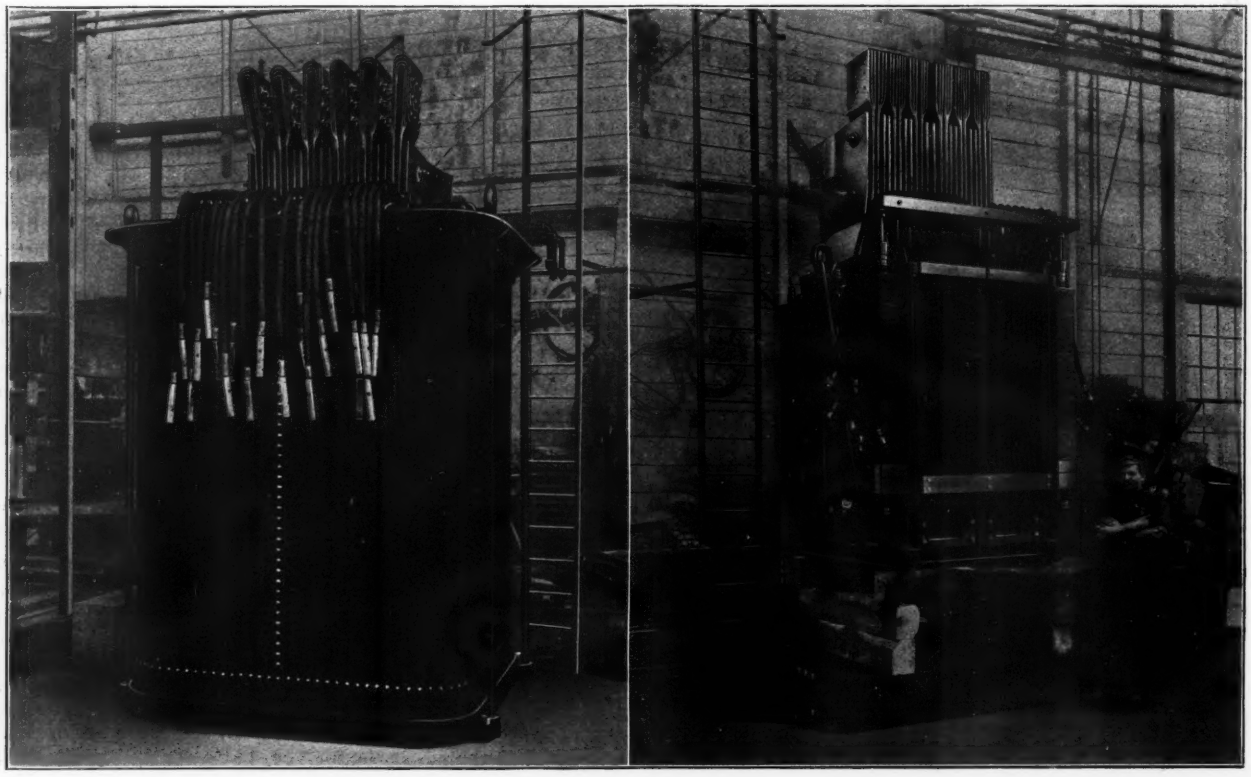
The largest static electric transformer ever built has recently been installed at the Niagara Falls works of the Pittsburg Reduction Company. The transformer was designed and built by the Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., and is to be used in connection with the manufacture or reduction of aluminum. In work of this sort electric furnaces are used, and in order to obtain high temperatures it is necessary to transform the current so that the amperage is exceedingly high and the voltage relatively low.

The primary current at the transformer has a frequency of twenty-five cycles at 2,200 volts. The secondary current is 80,000 amperes at twenty-five to fifty volts. The transformer occupies a floor-space of eighty-six and one-half inches by eighty-six and one-half inches. The height over all is eleven feet six inches and the gross weight with oil is 50,000 pounds.

The secondary winding consists of twelve coils of one turn each arranged so that by means of heavy switches they can be connected all in parallel, the several combinations giving a secondary current of 80,000, 40,000 or 20,000 amperes, the voltage in each case varying in an inverse ratio to the current.



DOUBLE REGULATOR IN OIL, EIGHT STEPS, 500 AMPERES, 2,400 VOLTS.



EXTERIOR AND INTERIOR VIEWS OF MAMMOTH TRANSFORMER BUILT BY THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY FOR THE PITTSBURG REDUCTION COMPANY, NIAGARA FALLS, N. Y.

The primary coils have a number of taps brought out at several points in the

windings. These taps connect to a special oil type regulator, which is shown herewith, by means of which the secondary voltage can be varied in suitable steps from maximum to minimum. Although the transformer is rated at 2,000 kilowatts capacity, it is possible to run it for long periods at 4,000 kilowatts capacity without overheating.

The transformer is of the oil-insulated, water-cooled type. The coils are thin slab wound, thus giving good mechanical construction as well as affording a ready dissipation of the heat generated in the windings.

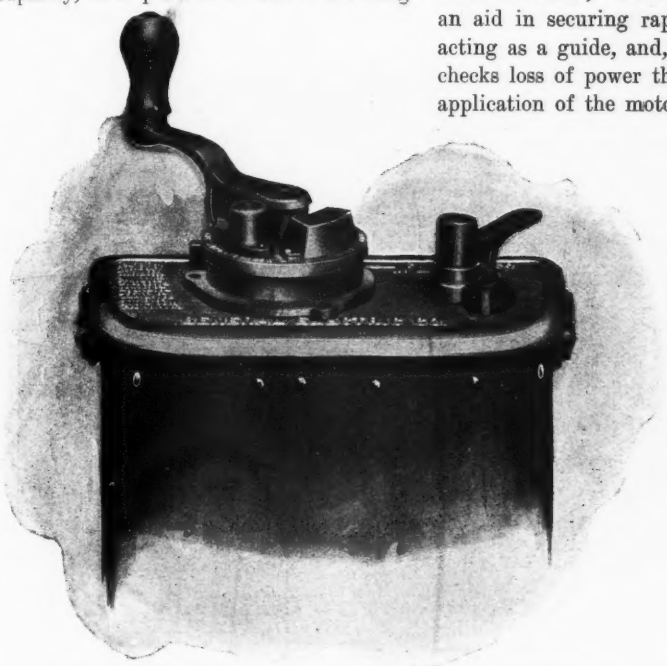


FIG. 1.—THE "AUTOMOTONEER" ATTACHED TO CONTROLLER.

FIG. 2.—STATIONARY ELEMENT OF "AUTOMOTONEER."

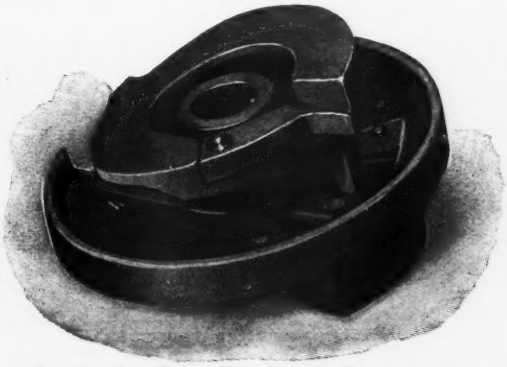


FIG. 3.—FOR FIXED RAPIDITY OF DISENGAGEMENT.

FIG. 4.—FOR ADJUSTABLE RAPIDITY OF DISENGAGEMENT.

The "Automotoneer."

The Garton-Daniels Company, Keokuk, Iowa, has placed on the market a street railway device designated as the "Automotoneer." This is a controller regulator, and is shown in Fig. 1 attached to a standard type K-10 General Electric controller. The same device may be attached to any nine-point controller, and the same principle has been worked out for practically all standard forms of controllers. The device is designed to obviate the waste of power or damage to motors and other car equipment by fast feeding. The "Automotoneer," the company claims, is an aid in securing rapid acceleration by acting as a guide, and, at the same time, checks loss of power through the careless application of the motor handle.

The device slips over the shaft of the controller, displacing the pointer collar on the top. Otherwise it leaves the controller intact. It is practically composed of two principal parts. One part is stationary (shown in Fig. 2), and is bolted to the top of the controller. The second part, shown in two styles in Fig. 3 and Fig. 4, revolves concentrically in the first in obedience to the movement of the controller handle, and, in effect, forms a part of the controller handle.

The device is made principally of malleable iron, case-hardened on the wearing surfaces. The stationary portion is in the form of a short, hollow cylinder, through which the controller spindle passes. A zig-zag channel is cast in the inside face of the barrel of the cylinder. This may be seen in Fig. 2.

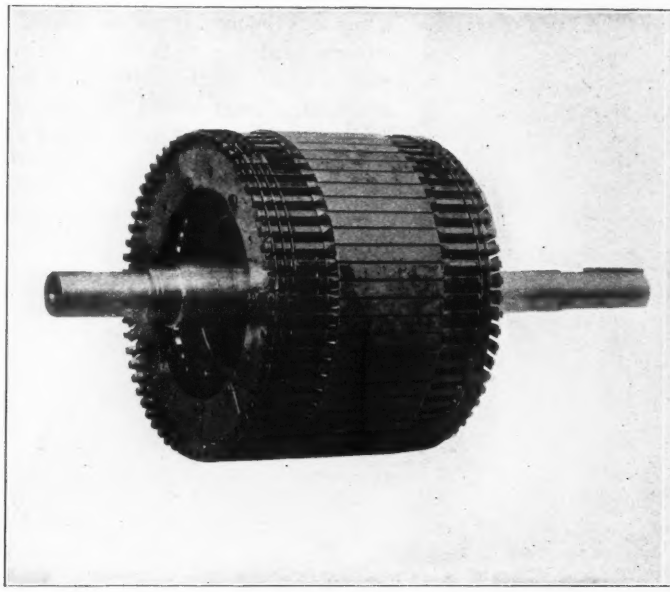
The part of the "Automotoneer" which revolves with the controller handle carries a pawl or dog. This may be seen very clearly in Fig. 2, Fig. 3, or Fig. 4. This pawl plays in the zig-zag channel in such a way that the pawl is pushed upward and engages a catch or tooth of the stationary portion each time the controller is moved one running point toward the on-position. It is then impossible to pass this point until the pawl has disengaged the tooth by dropping downward.

The device is made in two forms, style G and style G-A. In one the rapidity of the disengagement is fixed, the other being provided with an adjustable dash-pot whereby the rapidity with which this disengagement occurs may be varied after the "Automotoneer" has left the shop. Fig. 3 shows the former type, while Fig. 4 shows the latter type.

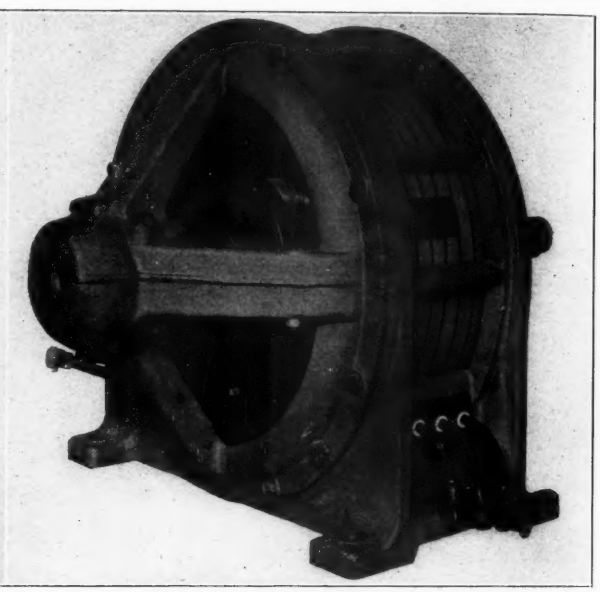
In operation the handle is placed in position, and moves from point to point. It is simply necessary to release the pressure against the handle after having taken a point. No backward movement of the handle is necessary to allow the pawl to fall in the zig-zag groove, if the device is properly adjusted so that the points of the "Automotoneer" match with the points of the star-wheel.

New Style Skeleton Frame Induction Motor.

The General Electric Company, Schenectady, N. Y., has recently put upon the market a new line of induction motors which embody certain details in construction of an interesting nature. This line of motors is now furnished in two styles, designated as form K and form L. As is generally known form K motors have the squirrel-cage armature, while the form L have resistance in the armature circuit. In both forms the stationary or field element is identical, the armatures being interchangeable.



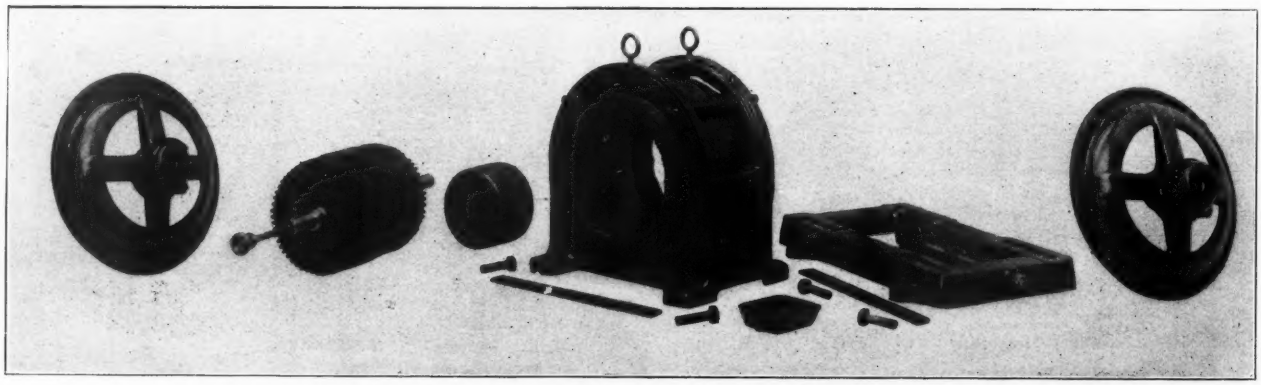
FORM K, ARMATURE FOR 220-VOLT INDUCTION MOTOR.



FORM L, 220-VOLT INDUCTION MOTOR.

The constructive detail which commends itself most to the attention of those interested is the skeleton frame of the machine, and the illustrations give an idea of its general appearance. In this construction the outer rim of the stator laminations is exposed directly to the air, thus reducing the weight of the motor, and greatly improving the ventilation. Notwithstanding the open construction of this motor, the characteristics of mechanical strength and rigidity are in no way sacrificed.

Another detail which is of more than speculative merit is the method of mounting the motors. In place of the ordinary V-rails and screws used for belt-tightening, is substituted a cast-iron base. This avoids change in alignment of motor due to tight belts, or, in a case where the drive is vertical, it eliminates the danger of having a motor slip from its base. This method of mounting motors can be used also when the motor is supported on side wall or from the ceiling. It was formerly necessary to use a different rail for side wall and ceiling work, but now in all motors from one to 200 horse-power, inclusive, this new method of mounting will be employed. The engraving makes clear the detail of the base.



FORM L, 220-VOLT INDUCTION MOTOR, DISASSEMBLED.

A third point in constructive detail is the use of adjustable end shields. Above thirty-five horse-power the motors are supplied with an adjustment at the bearings so that all wear may be compensated for and the stator and rotor kept in their proper relations to each other. Since it is necessary for reasons of efficiency to have the air-gap of any induction motor very small, this adjustment is quite a notable improvement as it prolongs the useful life of bearing-sleeves. By adjusting the air-gap so that there is more clearance on the bottom or wearing side, the motor can be run for a much longer period without readjustment. An uneven air-gap has no appreciable effect upon the efficiency power-factor, or heating of an induction motor, so that this adjustment is quite practical in all ways.

Due to these constructive details which have been mentioned, this line of motors possesses important electrical features

which ensure great efficiency and higher power-factor. The exceptionally low core loss and also the low friction losses make the efficiency very high at port loads. For variable load work, therefore, this motor is most economical in operation, and, due to these facts, it will undoubtedly hold a high place in the field now occupied by the old form of induction motor.

In common with the superseded motor type, this type of induction motor is made in both quarter and three-phase forms. For the same maximum output and efficiency, and equally good arrangement of copper, the three-phase motor has the advantage. This is due, primarily, to the increased amount of active conductor upon the armature. A representative three-phase motor having a power-factor of ninety per cent at full load and eighty-three per cent at half load will have about thirty-two per cent magnetizing current, 15.5 per cent reactance and a stationary impedance current of about 5.75 times full-load current. The same motor if wound two-phase will have thirty-two per cent magnetizing current and the same reactance (16.5 per cent) at full load, which will give a power-factor of eighty-nine per cent; while the half-load power-factor will be eighty per cent.

The results in the following table are approximate, but the same degree of approximation is used in each case, so that the comparison is quite fair. It will be seen from the table that the advantage of three-phase over two-phase winding is greater in the slow-speed than in the moderate-speed motors.

Motor.		Per Cent Power-Factor.	Per Cent Magnetizing Current.	Per Cent Reactance.
3-phase moderate-speed	full-load	90	32	16.5
	half-load	83		
2-phase moderate-speed	full-load	89	36	16.5
	half-load	80		
3-phase slow-speed	full-load	84	45	20
	half-load	69		
2-phase slow-speed	full-load	82	50.5	20
	half-load	65		

The above considerations show that two-phase motors have, inherently, a lower power-factor than three-phase motors, and are therefore not so desirable as a central station load.

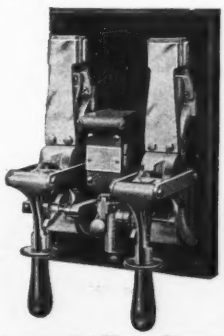
General Electric Circuit-Breakers.

A description of the General Electric Company's new type C, form P circuit-breakers will interest many of our readers, for these circuit-breakers embody the latest improvements and possess many points of merit.

The circuit-breaker is operated by means of a toggle mechanism which minimizes the force required to close the breaker. The toggle is stable in its closed position and yet can be easily tripped. The only change in position of the circuit-breaker handle when opened is a deflection of about forty-five per cent out and up. All the current-carrying parts are of polished copper, the operating mechanism having a smooth dull black finish. No springs or screws are used, the carbon contacts being sweated into clamping jaws, minimizing the likelihood of breakage. An easily adjusted laminated brush ensures an equal, positive pressure on every lamination, and automatically compensates for the ordinary wear of the contact surface. The main laminated contacts are adequately protected by two auxiliaries, the final break occurring on a carbon contact. The circuit is thus broken at three points.

860-AMPERE, 650-VOLT, SINGLE-POLE CIRCUIT-BREAKER.

The type C, form P circuit-breakers, in common with all those of General Electric manufacture, are so designed that the temperature rise of no part of the breaker will exceed moderate limits under normal conditions. This temperature rise will be comparable to the rise in temperature of the apparatus which the circuit-breaker is designed to protect.

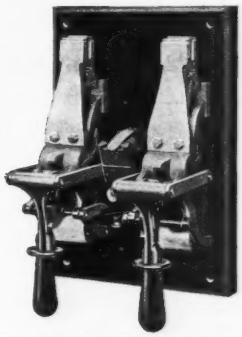


500-AMPERE, 250-VOLT, DOUBLE-POLE CIRCUIT-BREAKER.

The type C, form P circuit-breaker is back-connected and can be supplied either with or without base. The small capacity breaker has for its overload coil a wire-wound spool; circuit-breakers of intermediate capacities having polished copper, cylindrical coils. In the 800 and 1,200-ampere size the coil is replaced by a magnet frame encircling the lower stud, the current flowing through this stud being sufficient to secure the desired range of calibration.

The following auxiliary devices have been designed for use with standard overload breakers to protect systems from failure in voltage, reversal of current, underload, etc. These attachments can be furnished at any time and applied to the standard circuit-breaker without modification of the latter.

The object of the low-voltage release attachment is to trip the circuit-breaker when the line voltage drops to approximately fifty per cent or less of the normal voltage. It also performs the functions of a shunt trip when used in conjunction with a push-button, auxiliary switch, or speed-limiting device. For this reason it is generally to be preferred to the shunt trip attachment.



800-AMPERE, 250-VOLT, DOUBLE-POLE CIRCUIT-BREAKER.

The low-voltage release attachment consists of a solenoid acting on a plunger which is released by a reduction or cessation of the current in the solenoid. The motion of this plunger is transmitted to the tripping mechanism of the circuit-breaker by a single lever.

The shunt trip attachment has been designed to provide for conditions under which the low-voltage attachment can not be successfully applied. It resembles the low-voltage attachment in construction, but differs in that it trips the circuit-breaker when energized. The shunt trip solenoid should be allowed to remain only momentarily in circuit; hence it should be so connected that the opening of the circuit-breaker immediately disconnects it from the circuit. Whenever it is impossible to connect the shunt trip solenoid in this manner, the circuit-opening auxiliary switch should be used in connection with it.

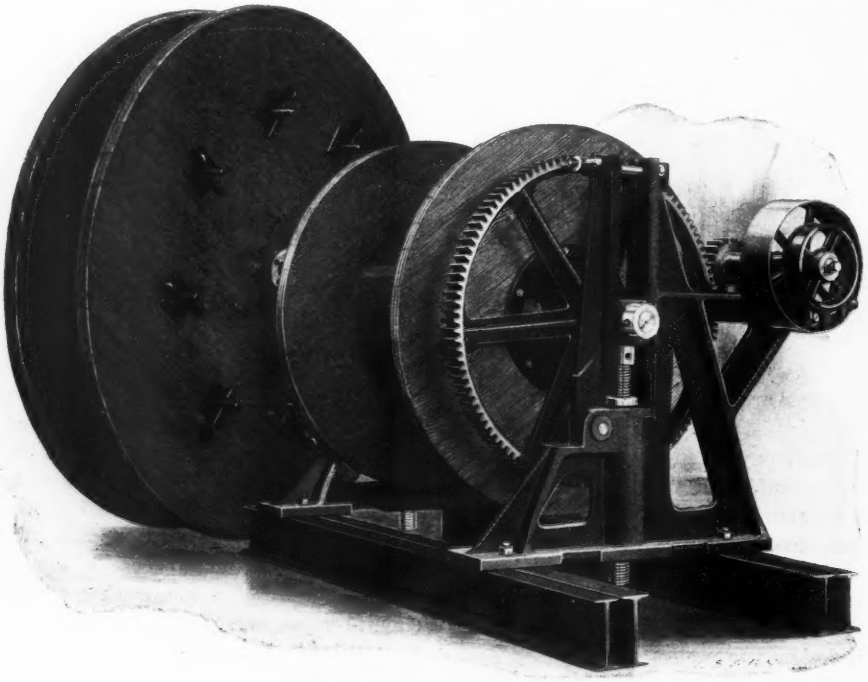
The circuit-closing auxiliary switch

closes when the circuit-breaker opens, and may be used to announce the automatic opening of the circuit-breaker, through the means of an indicating lamp or an alarm bell. It is often necessary to arrange one circuit-breaker so that, in opening, it will trip others. This may be accomplished by using a circuit-closing auxiliary switch in connection with a low-voltage or shunt trip attachment on the circuit-breakers to be tripped.

The circuit-opening auxiliary switch opens an auxiliary circuit when the circuit-breaker opens, and is intended to be used in connection with a shunt trip attachment to ensure the immediate disconnection of the shunt coil from the circuit. It may also be employed to serve other purposes, such as indicating by a lamp the open position of the circuit-breaker; tripping another circuit-breaker having a low-voltage attachment; and permitting another circuit-breaker to remain closed only when the circuit-breaker equipped with the auxiliary switch is open.

A Heavy Cable Reel Winding Gear.

The Aiton Machine Company, New York city, has designed a number of machines for cable manufacture. The accompanying illustration shows one of this company's winding gears for winding cables on large reels. The illustration shows a machine for belt-drive. The company, however, makes similar winding gears with electric motor-drives. This machine takes reels up to ten feet flange diameter.

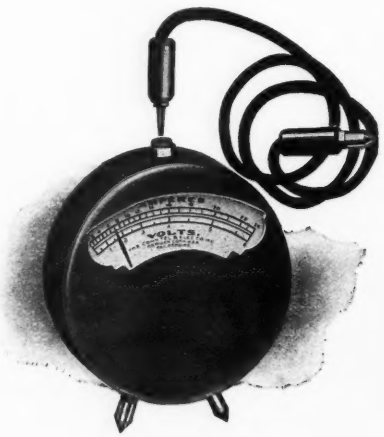


CABLE REEL WINDING GEAR.

The bearings for the reels are vertically adjustable, so that it is only necessary to raise the reel a fraction of an inch for rotating it.

New "Connecticut" Volt-Ammeter.

The Connecticut Telephone and Electric Company, Meriden, Ct., has placed upon the market a new type of volt-ammeter for electricians, telephone men, and automobilists. This instrument is an up-to-date battery tester and is especially designed for testing batteries in connection with gas engines and electrical instruments and is now coming into general use. It



VOLT-AMMETER.

is made up as a combination volt-ammeter, and with ampere reading only. The reading is from zero to thirty amperes and from zero to six volts. The instrument is carefully calibrated and the needle arranged for delicate and accurate reading, is guaranteed by the company to be accurate, durable and free from mechanical defects, and in this meter it maintains a high standard of quality.

"I-T-E" Circuit-Breakers.

The accompanying illustrations present several of the modern forms of "I-T-E" circuit-breakers manufactured by the Cutter Company, Philadelphia, Pa. Fig. 1 shows a circuit-breaker with "limit" attachment, especially adapted for crane work and other industrial service. This is a combined "limit" and "overload" circuit-breaker. It is supplied with two operating coils. One, the "overload" coil, in series with the switch, is always in circuit, and causes the instant opening of the switch upon the occurrence of a short-circuit or dangerously heavy overload, thus affording absolute protection to the motor.

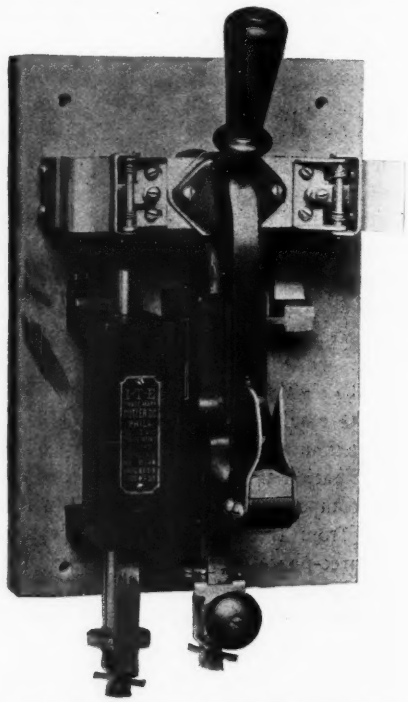


FIG. 1.—SINGLE-POLE CIRCUIT-BREAKER WITH "LIMIT" ATTACHMENT.

Should any foreign substance become engaged with the gears, or in any way interfere with the proper working of the machinery which the motor controls, the efforts of the motor to overcome the extra resistance result in excessive currents, causing the opening of the circuit by means of the "overload" coil. The "limit" coil is adapted to be brought automatically into circuit when the motor-driven mechanism has reached its safe limit of movement.

Fig. 2 shows a three-pole "overload" and "no-voltage" circuit-breaker for the protection of alternating-current motors. This circuit-breaker was brought out some years ago to meet the need for a protective device for polyphase motors. The "no-voltage" feature is so arranged that an open circuit in any one phase operates the

circuit-breaker, thus ensuring that the motor will remain in circuit only during proper running conditions.

Fig. 3 shows a single-pole circuit-breaker adapted especially to street railway serv-

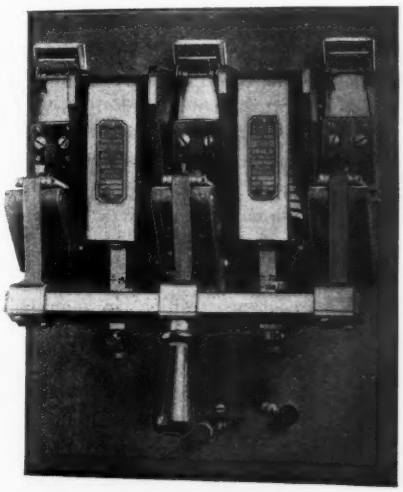


FIG. 2.—THREE-POLE "OVERLOAD" AND "NO-VOLTAGE" ALTERNATING-CURRENT CIRCUIT-BREAKER.

ice. This circuit-breaker, while it has been designed to meet the requirements of railway service, is not intended for the exclusive use of street railway companies, but may be used for practically every other class of installation where the utmost reliability under severe conditions is of prime importance. The simplicity of construction and careful proportioning of all parts minimize the possibility of break-

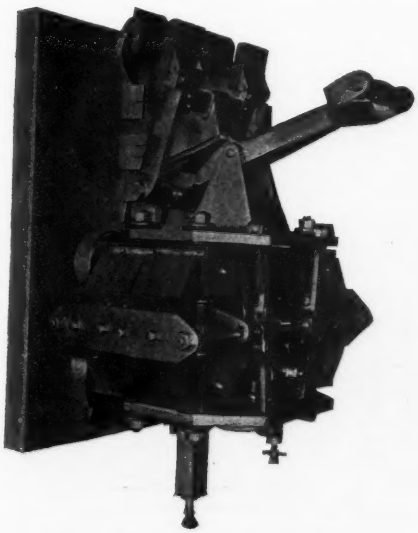


FIG. 4.—DOUBLE-POLE CIRCUIT-BREAKER. 10,000 AMPERES CAPACITY.

down. The calibration scale is long and easily readable from the front of the instrument.

Fig. 4 shows a double-pole circuit-breaker of 10,000 amperes capacity. This circuit-breaker was developed to meet special requirements for large capacities. The instrument is thirty inches high, twenty-four inches wide, and has a maximum depth when open of twenty inches from the switchboard to the most extended portion of the operating handle. The apparatus is equipped with a powerful double toggle operating mechanism, and has successfully withstood the tests incident upon long service, the maximum capacity at 250 volts being 10,000 amperes.

Fig. 5 shows the 2,500-ampere "Reversite," mounted on a pedestal. The ordinary "overload" circuit-breaker requires a certain amount of current for its operation, regardless of the direction in which that current flows. The "Reversite" feature of the "I-T-E" circuit-breaker is operated by currents in one direction only,

FIG. 3.—SINGLE-POLE CIRCUIT-BREAKER, "L-L" TYPE.

and to current in this direction it is extremely sensitive. Suppose four generators, each having a rating of 800 amperes, are operating in multiple, all fully loaded, each generator being protected by an "overload" circuit-breaker adjusted to open at 1,200 amperes. In the event of one of the generators dropping its voltage, either through breakdown in its field-circuit, short-circuited armature coil or coils, or the slowing down of the prime mover, the generator thus affected will cease to contribute to the external circuit, and the remaining three generators must carry the entire load of 3,200 amperes. Not only this, but they will deliver current reversely into the armature of the disabled motor, weakening its field and tending to cause it to operate as a motor. This reverse current will build up until operated by the action of the "overload" circuit-breakers. Before the instrument protecting the disabled generator can operate, the reverse current must reach a value corresponding with the circuit-breaker adjustment—1,200 amperes. The operation of the "Reversite" is to detect this reverse current instantly, and cause the proper

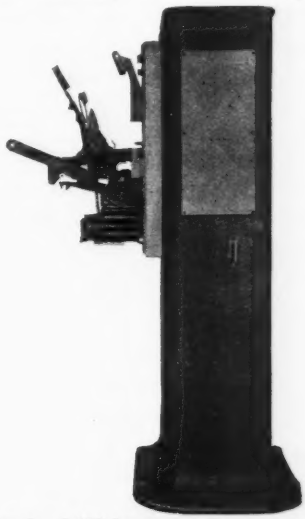


FIG. 5.—2,500-AMPERE "REVERSITE," MOUNTED ON PEDESTAL.

conditions to come about to protect the disabled generator.

Fig. 6 shows an "Auto-Directite" with "overload" and "reverse current" actuation. This is a type originated by the Cutter Company to meet the requirements

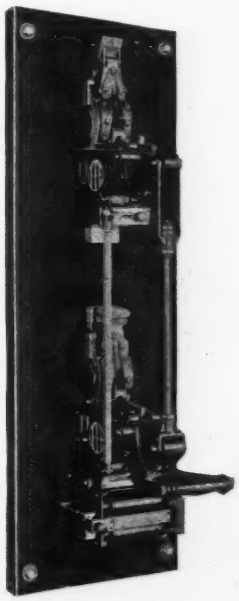


FIG. 6.—"AUTO-DIRECTITE," WITH "OVERLOAD" AND "REVERSE CURRENT" ACTUATION.

of the British navy, and is a double-pole circuit-breaker with the poles arranged in tandem, one above the other. In the present illustration the hand switch, with accompanying connections, is eliminated. The apparatus can not be closed or held closed while the conditions against which it is designed to give protection exist in the circuit. To open it manually, however, takes but a slight upward movement.

Series Alternating-Current System of Arc Lighting.

The Fort Wayne Electric Works, Fort Wayne, Ind., has recently developed a complete system for series arc lighting circuits which may be readily operated upon a constant-potential supply.

Although the many advantages of the alternating-current system for series arc lighting are well known, and although systems of this nature have been in operation throughout the country for some time, the further advantages of a simple system, requiring but slight attention, which is sufficiently flexible to operate in parallel with an incandescent system if desired, will at once be manifest.

The system described in these columns consists of a regulator for maintaining a constant current, a specially designed high-tension switchboard, a constant-potential transformer, and a series of arc lamps. In addition, both sides of the line are equipped with a lightning arrester peculiarly adapted to circuits of this nature.

Fig. 1 represents the type SA regulator

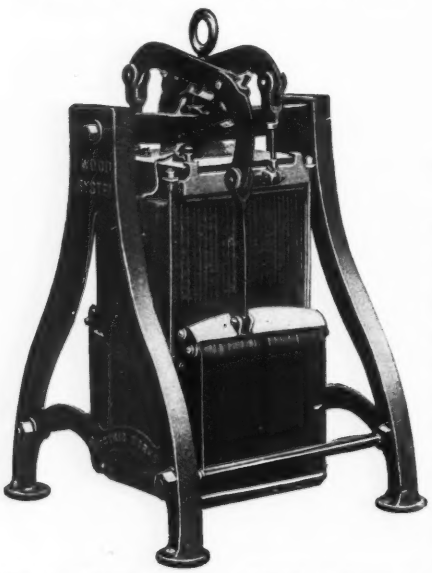


FIG. 1.—REGULATOR FOR SERIES ALTERNATING-CURRENT SYSTEM OF ARC LIGHTING.

which has been designed for this system. Its operation depends upon the automatic introduction of impedance into the lamp circuit whenever any decrease in the resistance of the latter would tend to cause an excessive current to flow therein. This impedance is introduced by the combined movements of a laminated iron core and impedance coil into such a position as to cause a greater magnetic flux to be cut by the current in the coils. This increase in the amount of flux cut by the line current produces a choking effect, reducing the latter to its normal value. If, for any reason, the line current be decreased, the exact opposite effect takes place within the regulator and the current is automatically increased to its normal value.

The mechanical parts of this regulator are so well counterbalanced that the motion of the heavy core is small as compared

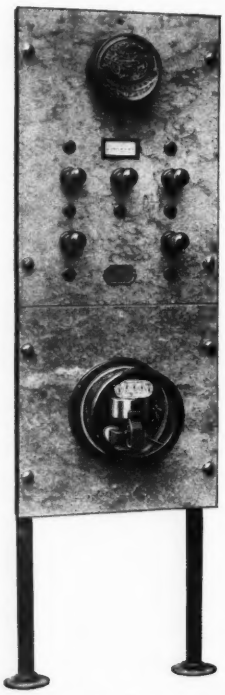


FIG. 2.—SWITCHBOARD, SERIES ALTERNATING-CURRENT SYSTEM OF ARC LIGHTING.

with that of the coil. This reduces the inertia and guarantees an immediate and more sensitive adjustment of the current. This design also permits the core and the coils to counterbalance each other, and does away with the use of the counterweight, thereby simplifying the design and reducing the necessary attendance.

This regulator, being very compact in form, requires a floor space of but twenty-two inches by twenty-eight inches in the seventy-five-light capacity and may be located upon the floor of the power station in any convenient position. No attention is required at the regulator, the starting operation being entirely controlled from the switchboard specially designed for this purpose.

The switchboard furnished with this system consists of a single panel of blue Vermont marble, equipped with ammeter, reactance, fuses, and all necessary switches for the starting and operation of the system. It can be furnished with or without a wattmeter subbase equipped with an integrating wattmeter. Fig. 2 represents the front of the switchboard for use with step-up transformer and integrating wattmeter.

By reference to the accompanying diagram, Fig. 3, the peculiar design will be noted by means of which the system may be quickly started from the switchboard without paying any attention to the regulator and without causing any excessive rush of current through either the regulator or the lamps in so doing. The ability to thus start the system without any disturbance upon the line is one of the greatest advantages of the Fort Wayne system.

The starting switch, which is located in the centre of the panel, should always be closed last. In the closing of this switch, three separate stages exist.

At the first stage in the closing of this switch, a reactance, which is mounted upon the back of the switchboard, is introduced into the regulator circuit, so that no rush of current will take place when the regulator is thrown upon the line. If it were not for the introduction of this reactance, the regulator, which is in its no-load position, introducing but very little impedance in the circuit, would permit an excessive current to flow. With the introduction of the reactance, however, the current is choked down to its normal value until the regulator comes to its full-load position, in which position it

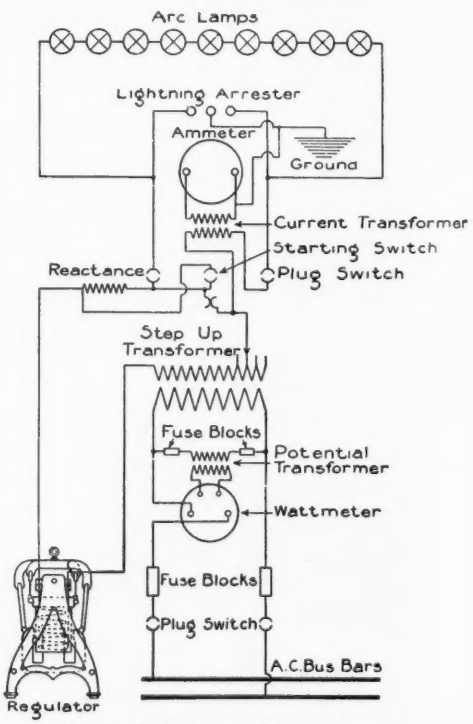


FIG. 3.—DIAGRAM OF CONNECTIONS.

introduces a sufficient impedance of its own to reduce the current to its normal value.

The second stage in the closing of the starting switch short-circuits the above reactance, thus throwing the regulator,

which has now reached its full-load position, directly across the constant-potential bus-bars. During both these stages the line leading to the arc lamp is short-circuited.

When the starting switch is entirely closed the short-circuit across the line which previously existed is removed, thus permitting the line of arc lamps to operate in series with the regulator upon normal current. By thus connecting the lamps into the circuit after normal current has already been maintained, no disturbance is caused in the mechanism of the lamps.

Although the systems for twelve and twenty-five lights will operate satisfactorily without the use of a constant-potential transformer upon circuits of 1,100 and 2,200 volts respectively, it is advisable to use a transformer in all cases, although it may be of a one to one ratio, introduced merely for insulation purposes. This is especially desirable where both arc and incandescent systems are operated from one set of bus-bars, in order to entirely insulate the arc system from that which supplies the incandescent lamps.

FIG. 4.—CONSTANT POTENTIAL TRANSFORMER DEVICE FOR ALTERNATING-CURRENT SYSTEM OF ARC LIGHTING.

Fig. 4 represents a constant-potential transformer supplied with this system which may step up or step down the bus-bar voltage or may in some cases maintain the same voltage upon both primary and secondary in cases where it is introduced for insulation purposes only. The secondary of this transformer is provided with a number of taps, by the use of which the output of the station may be varied as more arc lamps are needed upon the circuit, maintaining at all times practically full-load efficiency and power-factor. The advantage of this will be at once apparent. If a regulator and transformer be purchased of sufficient capacity to meet the needs of a growing system, the latter may be connected at first so as to supply only a small portion of its total output, and, as the number of arc lamps increases, the taps upon the transformer may be so connected as to meet this demand with no further cost of installation. This may be done with practically no sacrifice of efficiency when operating the circuits of small capacity.

The alternating-current series arc lamps which have been designed to operate in connection with this system are of the same high grade and long life which is characteristic of the direct-current product. They will be found to operate with extremely low temperatures for periods of time up to 125 hours with but one trimming, when adjusted for normal current of 6.6 amperes.

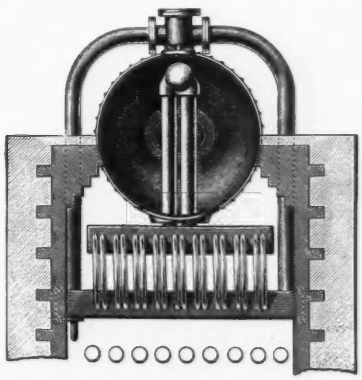
The disadvantages which so often occur in alternating-current arc lamps have been reduced to a minimum in this design, great care being taken to prevent vibration and the consequent hum which frequently exists in lamps operated upon alternating-current circuits.

The system has been designed for either sixty or 140 cycles and has been found to operate with entire satisfaction upon both of these frequencies. The 140-cycle lamp has been especially designed for high-frequency service and can not be operated upon a sixty-cycle circuit. Although the use of the sixty-cycle system is advised wherever possible, owing to the fact that it is at present the tendency for central stations to reduce the frequency of their system, the central station managers who already have 140-cycle circuits in use will find that this system will operate with entire satisfaction.

Superheated Steam.

One of the features in the advance of modern engineering practice is the rapid increase in the use of superheated steam in power plants as a means of decreasing fixed operating expenses. That the high engine efficiency theoretically possible by the use of multi-cylinder high-expansion engines is not obtained without the use of superheated steam, is due principally to cylinder condensation and other heat losses in the steam mains, incidental to the presence of water. In the best engines fully twenty-five per cent of the heat energy of the steam generated in the boiler, and theoretically available for power purposes, is lost in this way, with a very considerable increase in many cases on account of inferior design and proportion. With a moderate degree of superheat, steam main and cylinder condensation can be entirely prevented and a marked increase in efficiency obtained. Authentic tests have shown a coal pile saving of from ten to forty, or in some cases fifty, per cent by the substitution of moderately superheated steam, for what was ordinarily commercially dry steam.

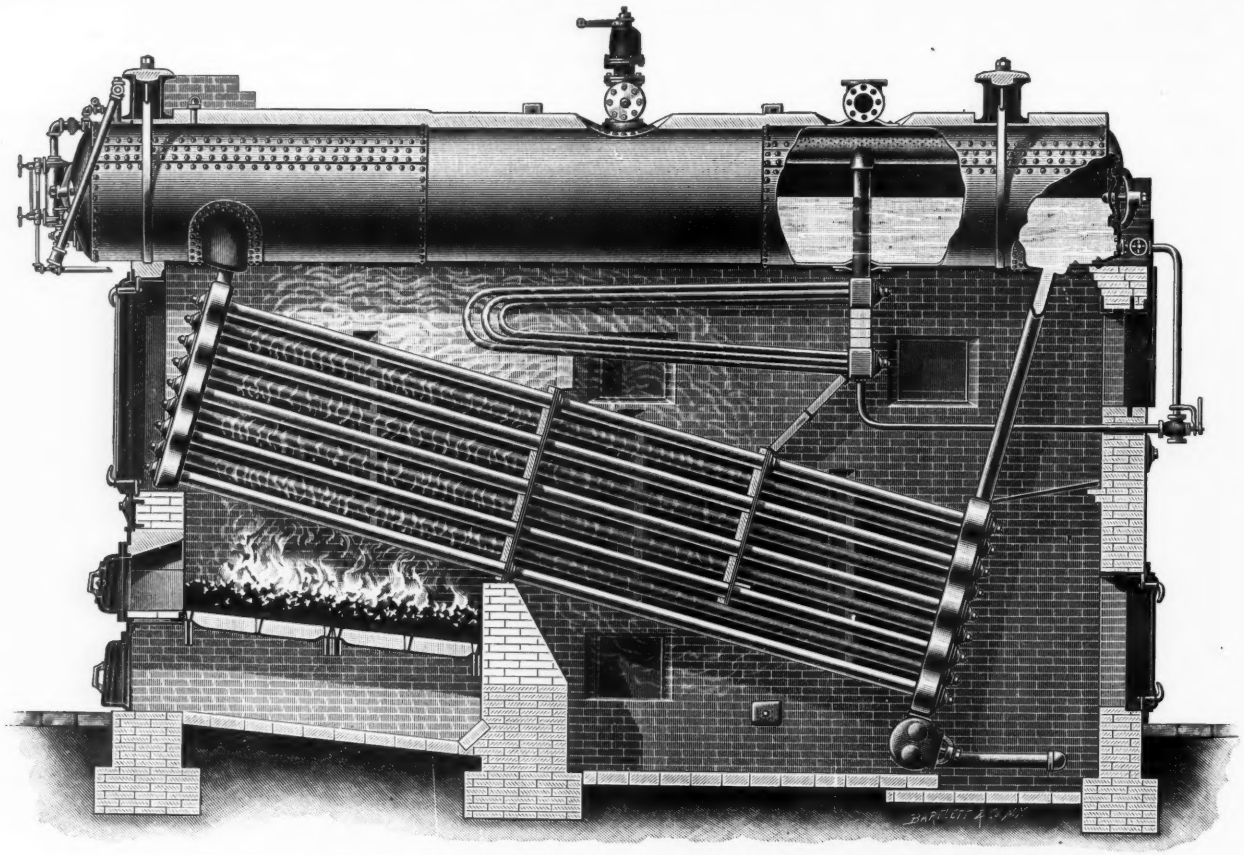
Some years ago, stimulated by a demand in connection with its foreign business,



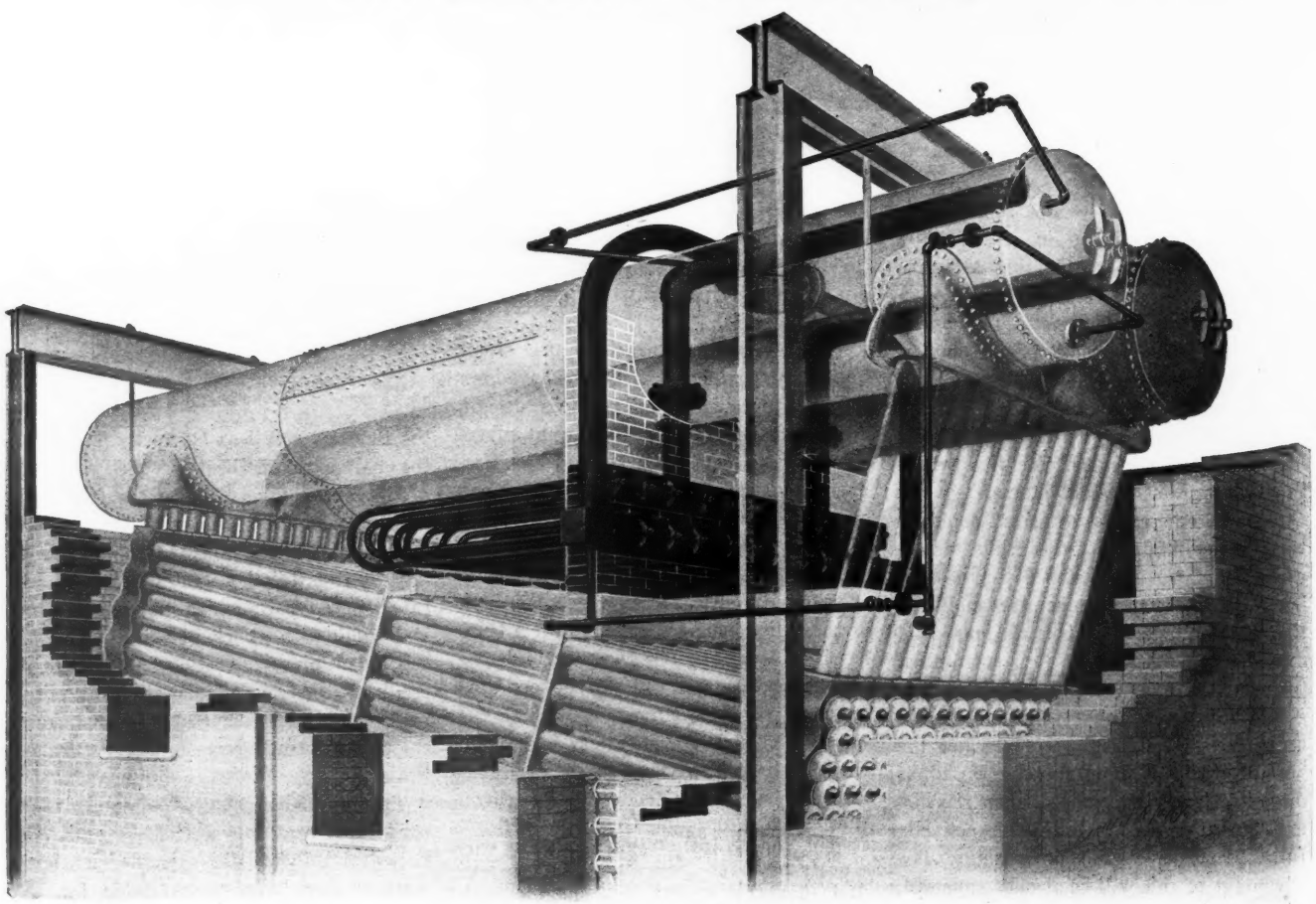
SUPERHEATER OUTLET COLLECTOR CONNECTIONS.

the Babcock & Wilcox Company placed on the market a superheater, which, because of its simplicity, efficiency, safety and durability, merits attention. As may be seen by reference to the accompanying figures, it is tubular in design and is located in a space which permits its installation without change in design of setting or pipe connections and leaves it readily accessible for inspection, cleaning and repairs and perfectly protected from the deteriorating effect of radiant furnace heat.

The superheater consists of solid drawn steel tubes bent into a U-shape and connected at both ends by expanded joints to wrought steel boxes or manifolds, the upper box being connected to the steam and



Babcock & Wilcox Water-Tube Boiler, Fitted with Superheater.



Phantom Drawing Showing Babcock & Wilcox Superheater Attached to Water-Tube Boiler.

water drum by means of mild steel tubes attached by expanded joints into the box, and also into a nozzle provided for that purpose on the underside of the drum. The upper end of this pipe is connected to the usual dry pipe located in the top of each steam drum. The lower box or manifold is connected to an outlet collector or cross-pipe by mild steel tubes expanded at both ends. This outlet collector carries the steam flange from which superheated steam may be conducted to the point where it is desired to use it. An arrangement of piping and shut-off cocks connected to the steam drum below the water line and to the lower box or manifold provides a means of flooding the superheater in order to protect it from the sudden variations of high temperature, incidental to the raising of steam when the fires are started and before the steam circulation is commenced.

The valves are so arranged that as soon as ten to twelve pounds of steam pressure is obtained in the steam drum the water can be blown out and the superheater left ready for operation when the consumption and the generation of the steam begins.

Over 5,000 of Babcock & Wilcox superheaters are in use at present, many of which have been running for over ten years, giving entire satisfaction and requiring no repairs of any sort. They appear to be as reliable and durable as any other part of the boiler, and in works where they are installed experience shows that they require so little attention that their presence is really unknown.

Such little soot as can accumulate on the top of the superheater tubes is readily blown off through dusting-doors provided for that purpose, so that at all times the desired degree of superheat is obtained by using known proportions between boiler heating surface and superheating surface, while regulation and control of temperatures with varying rates of evaporation are practically automatic because the temperature of the superheater chamber varies with the furnace temperature, while the rate of flow and consequent time of exposure of steam in the superheater are proportional to the rate of generation.

As a superheater must of necessity be exposed to the various extremes of temperature as well as to the chemical elements in the furnace gases, the absence of any expanded or other joints or gaskets located in the direct pass of impinging gases is one of the principal reasons for the success, durability and efficiency of the Babcock & Wilcox superheater.

Some Recent Bullock Electrical Machinery.

During the past two or three years the Bullock Electric Manufacturing Company (electrical department of Allis-Chalmers, Milwaukee, Wis.) has done a great deal of development work on new electrical apparatus, and the following is a brief description of a few machines recently brought out:

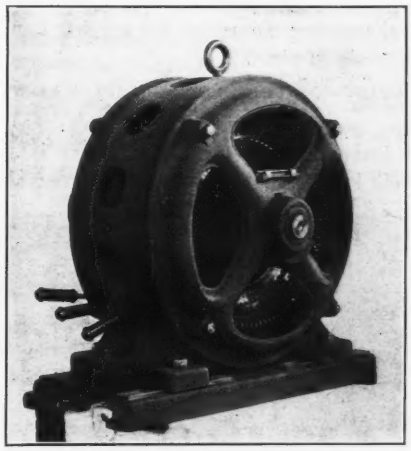


FIG. 1.—EIGHT-POLE, TWENTY-HORSE-POWER, SIXTY-CYCLE BULLOCK MOTOR.

INDUCTION MOTORS.

A complete line of induction motors for sixty cycles and twenty-five cycles has been developed which, being of modern design, include all the features that have been found most desirable in apparatus of this class. Most of those at present constructed are of the squirrel-cage type, though a number of the larger sizes have been built with wound rotors for starting with external resistance, and eventually a complete line for all work where secondary resistance is required will be brought out. Fig. 1 shows a standard eight-pole, twenty-horse-power, sixty-cycle motor. The stator housing is designed to allow free ventilation and at the same time secure strength combined with light weight. The ring-oiling bearings are carried in the end shields, and in large motors are made adjustable to allow compensation for unevenness in the air-gap due to wear in bearings. The end shields can be fitted with perforated covers for semi-enclosure, or if a totally enclosed motor is required, solid cover-plates can be used. By shifting the shields through ninety degrees or 180 degrees, the motors can be adapted for side-wall or ceiling suspension.

By careful design, high power-factor and efficiency have been obtained, and good starting torque with moderate current is made possible.

Potential starters are used for starting squirrel-cage motors, since with them the voltage applied to the motor and the current taken from the line are reduced during the starting period. The potential starter consists of a pair of autotransformers for reducing the voltage, and an oil switch for changing over the connections from the starting to the running position. In starters for small motors the

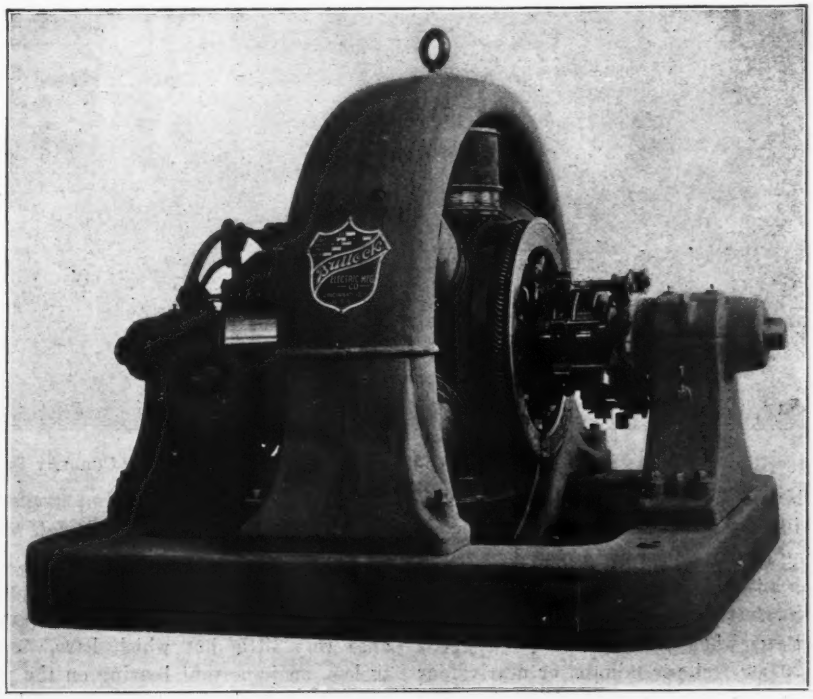


FIG. 2.—300-KILOWATT BULLOCK ROTARY CONVERTER.

autotransformers and oil switch are mounted together in one case, while with large motors they are arranged separately, the autotransformer as well as the switch being immersed in oil.

This company has built some of the largest induction motors so far constructed and is manufacturing these machines in all sizes and for all classes of service.

TURBO-ALTERNATORS.

The Bullock company has recently designed a number of turbo-alternators for direct-connection to Allis-Chalmers steam turbines. The field is a smooth cylinder in its general outline, the exciting coils being of flat copper strip placed in radial slots and held securely by bronze wedges. So perfect is the balance of these fields that even when tested at a peripheral speed of 20,000 feet per minute, or nearly four miles per minute, no vibration is noticeable. The stationary armature or stator is of the same general construction as for standard Bullock revolving-field alternators, though the proportions are very different, the number of poles being much smaller and the depth of iron under the slots correspondingly greater than in low-speed engine or water-wheel type machines. Particular care is taken in building up the armature core and in insulating the laminations so as to avoid eddy currents. The end-connections of the armature coils in turbo-alternators are long, because of the large pole pitch, and special means are provided for holding them securely in place.

ROTARY CONVERTERS AND DIRECT-CURRENT GENERATORS.

Bullock direct-current machinery is so well known that little comment regarding it is here necessary. Improvements are continually being made, though some of these may not be apparent at first glance, since they relate for the most part to details which affect the general appearance very little but which have, nevertheless, an important bearing on the performance of the machine. Special attention has been paid to details affecting ventilation. In some cases the commutators have been provided with open necks and in others the field coils have been constructed so that the inner portions of the windings are ventilated.

Fig. 2 shows a recently designed rotary converter having an output of 300 kilowatts at 500 revolutions per minute. It converts from 380 volts alternating current at twenty-five cycles to 600 volts direct; being intended for a fluctuating railway load, it is provided with a series field winding for compounding and is made very substantial throughout to withstand the exacting requirements of railway service.

Fig. 3 shows one of four large engine-type direct-current generators recently built, set up temporarily for testing. It has an output of 800 kilowatts, 250 volts, at ninety revolutions per minute. The field has twenty poles and the armature is ten feet in diameter. This is about the maximum size that can be shipped complete; larger armatures must be built up in place. The field coils are of the ventilated type and the series winding is of heavy copper bar wound on edge. The commutator has long open necks which give very efficient ventilation and the whole brush yoke is mounted on trunnions so as to be shifted back and forth through a small distance parallel to the shaft, thus keeping the commutator from wearing in ridges. The trunnions are moved back and forth by a cam and ratchet device operated by an eccentric on a small shaft driven from the main generator shaft.

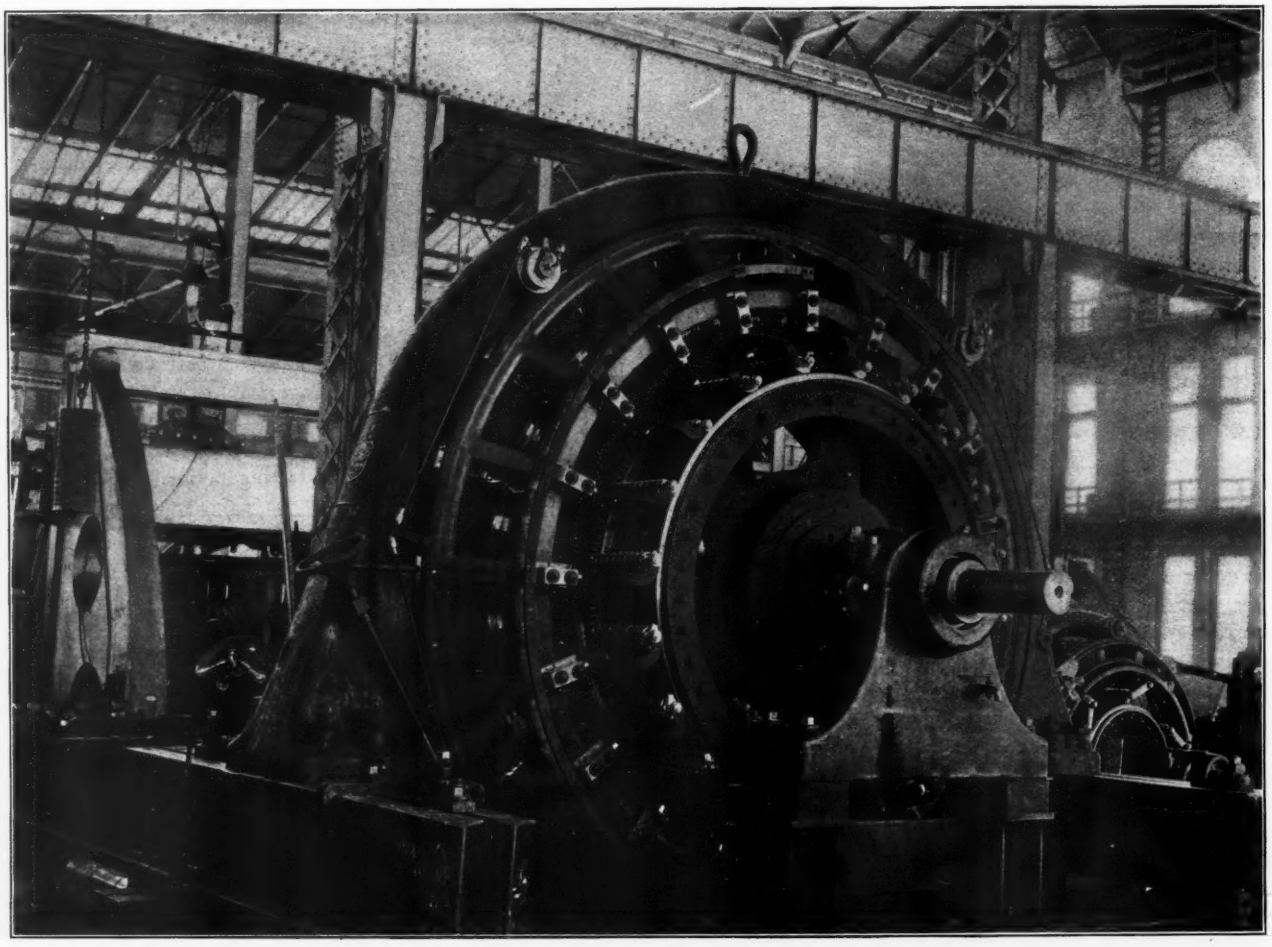


FIG. 3.—800-KILOWATT, ENGINE-TYPE DIRECT-CURRENT BULLOCK GENERATOR.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

MEXICAN STREET CAR OPTION—J. W. Conger recently secured an option on the Chihuahua, Mexico, street car system, which will be changed to electricity.

TOLEDO MUNICIPAL LIGHTING PLANT—The Toledo, Ohio, council has passed a resolution allowing the issue of bonds amounting to nearly half a million dollars for the construction of a municipal lighting plant.

THE TOPEKA EDISON COMPANY—A new corporation, the Topeka Edison Company, has been granted a charter. This company is backed by the same interest controlling the City Railway Company and the Edison Electric Illuminating Company. The following officers have been chosen: L. E. Myers, president; E. W. Wilson, vice-president; A. H. Purdy, secretary; George D. Caldwell, treasurer. Board of directors: L. E. Myers, E. W. Wilson, George D. Caldwell, M. A. Low, B. E. Sunny, J. E. Hurley, W. A. L. Thompson, F. G. Kelly, George Taylor. C. R. Maunsell will be the general superintendent of the plant.

GREAT BRITAIN'S TELEPHONES—Great Britain is preparing to add a telephone system to its post-office department, and to that end has entered into agreement with the National Telephone Company by which, six years hence, the plant of the company, which has a capital of $45,000,000, will be bought by the nation. In the meanwhile post-office subscribers will obtain free intercommunication with the company's system. When the post office takes over the business of the telephone company about 15,000 employés will be added to the government payroll. The company has 326,017 stations or instruments, which bring in an annual revenue of $10,000,000. In London alone there are 73,783 stations.

DAM FOR ELECTRIC POWER ON THE MISSOURI RIVER—The Helena, Mont., Power Transmission Company has awarded the first of a series of contracts aggregating $1,500,000 for building a dam across the Missouri river, twelve miles from Helena. This contract is for the steel to be used in the dam proper, and the remaining contracts will be let shortly. The steel dam is to be completed, it is stipulated, by May 1 next, and it is expected that the company will begin the transmission of electric power to Helena, Butte and Anaconda within ten months. About twenty thousand horsepower will be developed, and this will be utilized chiefly in the Amalgamated smelters at Anaconda and in milling points between there and Helena, as well as for lighting and street car purposes in the cities mentioned.

EXTENSIVE CALIFORNIA TELEPHONE SYSTEM—The Home Telephone Company, San Francisco, Cal., recently filed articles of incorporation for its branch concerns in Stockton, Oakland, Fresno and San Jose, the principal business office of the company being in San Francisco. The incorporations are for a period of fifty years, with varying amounts of capitalization in each city. The Oakland branch is incorporated at $3,000,000, with $30,000 subscribed; Stockton $1,500,000, with $20,000 subscribed; San Jose $2,000,000, with $30,000 subscribed, and Fresno $2,000,000, with $30,000 subscribed. The directors of the Oakland branch are William Thomas, Thomas G. Parkhurst, Jr., L. S. Ackerman, J. E. Schoenfeld, J. Robinson, L. Webster and William L. Gerstle, each subscribing $5,000. Excepting the last two named these are the directors of the other branches.

FAST ELECTRIC LINE FROM BALTIMORE TO WASHINGTON—The Baltimore Terminal Company has been organized as a subsidiary company of the Washington, Baltimore & Annapolis Railway, to construct a terminal in Baltimore to accommodate the cars of the Washington, Baltimore & Annapolis. An ordinance is already pending before the city council to permit the parent company to operate its suburban cars in the city, having Baltimore street and Hopkins place as its central station. The advantage to the company in such a location is that it will be within two blocks of the heart of the shopping district. The statement is made by George T. Bishop that the subsidiary company has $5,000,000 to spend on its improvments at that point and proposes to go ahead with the work at once. Touching the service which is to be given on the Washington, Baltimore & Annapolis, George T. Bishop, the president of the road, says it is the intention to have at least three, and possibly four, cars each way an hour between Washington and Baltimore, while the service to Annapolis will be complete, although not quite so frequent. Each of the cars will be equipped with four motors, developing each 125 horse-power. These will permit the road to run its cars at the rate of seventy miles an hour if necessary.

CHICAGO CAR LINE PLANS—The preliminary report of A. B. DuPont for the municipally operated street car lines in the city of Chicago, Ill., has been submitted to the mayor and transportation committee. In this report Mr. DuPont gives rough estimates for a complete 264-mile system, with two power-houses, a 100-pound rail track and rolling stock equipment, consisting of between 1,000 and 1,200 cars of the large platform type now in use in St. Louis. These cars are a little shorter than the new cars installed on the Union Traction system, and perfectly plain inside, so as to afford little opportunity for dust and germs to accumulate. The cost of the cars is estimated at about $6,000 each. The total cost of the system, including power-houses, but providing for all overhead trolleys and surface lines, is $25,000,000. Mr. DuPont gives an alternative plan for a subway in Wabash avenue, State or Clark street in event the city loses its legal fight with the city railway over the franchise in Wabash avenue. In this plan Mr. DuPont uses the Arnold estimates for a subway and figures the cost, not including damages to abutting property, at approximately $1,000,000 a mile. He provides for two and one-quarter miles of this subway, which would bring the total cost of his 264-mile system up close to $28,000,000.

ELECTRIC RAILWAYS.

BALTIMORE, MD.—The Hagerstown Railway Company will double its power plant.

SCRANTON, PA.—A charter has been issued to the Scranton & West Side Street Railway Company, with a capital of $24,000, to build three and one-half miles of road in Scranton.

WOLCOTT, N. Y.—A movement is now on foot among the residents along the shores of Lake Ontario in the northern part of the town of Wolcott to construct a road across the marsh connecting Desbrough park and Bigelows corners.

GALLIPOLIS, OHIO—John C. Shepard is negotiating with property owners and the city council for a right-of-way line for Gallipolis, which it is intended to extend to Port Pleasant and Pomeroy. It is said that Mr. Shepard has pledges of $75,000 of outside capital for the venture if the right of way is given the new company.

LORAIN, OHIO—An agent for the Lake Shore Electric road announces that a party of engineers has started east from Norwalk to survey a new line to Oberlin for the Lake Shore Electric. The new line will pass through the hamlets of Kipton, Penfield, Brighton and Collins. These places are already touched by the Cleveland & Southwestern.

KALAMAZOO, MICH.—To save the building of sixteen miles of track, the Kalamazoo, Lake Shore & Chicago Traction Company has purchased the Michigan Central track between Kalamazoo and Mattawan. The stretch of track was until recently part of the main line of the Michigan Central, but since the building of the new double track has been practically abandoned.

CLEVELAND, OHIO—Contracts have been awarded for equipping the West Shore Railroad with electricity from Utica to Syracuse, N. Y. The Andrews-Vanderbilt syndicate states that it has

signed papers with an electrical construction company of New York for the work. The New York Central will take care of the tracking. No contracts for the rolling stock have been made, the managers of the road being still undecided as to the type of car.

ELIZABETH, N. J.—Work has been started at Bayway, in Elizabeth, on the construction of a trolley line to Camden.

LAS VEGAS, N. MEX.—Work on the extension of the Las Vegas electric line and the power-house has been begun. With its completion Las Vegas will have thirteen miles of electric road.

ELMIRA, N. Y.—The Elmira & Seneca Lake Railway Company, which for about four years has operated an electric railway between Horseheads and Watkins, has passed into the hands of a receiver.

SPRINGFIELD, OHIO—General Manager Theodore Stebbins, of the Appleyard traction lines, says that the company will build a new traction station in Springfield as soon as the properties can be cleared of the receivership.

EASTON, PA.—Harry C. Trexel, of Allentown, president of the newly reorganized Lehigh Valley Transit Company, has signed contracts with the General Electric Company for an entirely new outfit of machinery at the Allentown power-house.

GUTHRIE, OKLA.—J. C. Markham and C. C. Johnson, of Chicago, are projecting a line of railway between Turner's Falls and Davis, I. T., in the Arbuckle mountains, with an extension to Sulphur Springs, where the government is building a mammoth health resort.

KANSAS CITY, KAN.—The board of county commissioners of Wyandotte County has granted a thirty-years' franchise to the Kansas City, Olathe, Lawrence & Topeka Railway Company for a portion of the new electric line which will run through Wyandotte County.

ALLIANCE, OHIO—Promoters of the new electric line from Alliance to Akron have decided to ask for a charter under the name of the Alliance-Akron-Cleveland Railroad Company. The company is to be incorporated with $50,000 capital, this sum to be raised later to $800,000. Hugh Bleakley is the organizer of the company.

WORCESTER, MASS.—George S. Taft, receiver of the Hampshire & Worcester street railway, announces that the road will be sold at auction September 16 at Ware. The line extends from West Brookfield to Ware, thence to Gilbertville, a total distance of about twelve miles. There are mortgages for $400,000 given to the American Loan and Trust Company, trustee for the bondholders.

SAN FRANCISCO, CAL.—It is now intended to make the proposed electric line from San Francisco to Santa Cruz a double-track road instead of a single-track line, as originally planned. This change in the company's plans will involve an increase in the capital stock from $3,000,000 to $5,000,000 and the creation of a bonded indebtedness of $5,000,000. A meeting of the stockholders of the company has been called to act on the proposition.

NORRISTOWN, PA.—A trolley line from Norristown to Ambler *via* Centre Square and Blue Bell is contemplated. Surveyors are working on a route to run from Centre Square, down the Skippack Pike to Blue Bell and Broad Axe, thence direct to Ambler, terminating at the Philadelphia & Reading station in that borough. The promoters are the officials of the Montgomery Traction Company, the recent purchasers of the Landsdale & Norristown line.

PITTSBURG, PA.—The merging of the traction and lighting interests of the Mahoning and Shenango valleys under the Mahoning & Shenango Traction and Light Company is supplemented by the application for a charter for the Crawford County Railways Company, which is to operate trolley lines in Erie, Crawford, Mercer and Venango counties. The new company is to operate, it is said, in conjunction with the Mahoning & Shenango.

ALLENTOWN, PA.—Mayor Tom L. Johnson, of Cleveland, attended a meeting of the directors of the newly reorganized Lehigh Valley Traction Company, on August 25. The directors made further contracts for the remodeling and equipment, which will cost a total of $1,100,000. The old power-houses will be abandoned on both the Lehigh Valley and Philadelphia trolley lines and replaced by a central high-tension plant to be built at Allentown. A promise was also made of much cheaper electric light rates.

CHICAGO, ILL.—Progress is being made in the construction of the Toledo & Chicago Interurban Railway line and the Fort Wayne division, extending from Fort Wayne to Garret, Kendalville, Auburn Junction, Waterloo and Butler, Ind., will be in operation this fall, according to statements by the company. The proposed trackage is more than 150 miles and will close the open link which exists at present in the electric railways between Toledo and Chicago. F. E. Seagrave is president of the company.

NILES, MICH.—Harris F. Holland, president of the Holland Palace Car Company, of Indianapolis, and also president of the Columbia, Gramsby & Richmond Traction Company, is at the head of the movement contemplating the building of another interurban electric line from Niles to Kalamazoo *via* Cassopolis and Diamond Lake. The company is to be comprised of Niles and Cassopolis capitalists. The line will be about fifty miles long, and will touch at each of the chain of lakes which are popular summer resorts.

JOPLIN, MO.—The electric line that is building toward Columbus from Pittsburg is now under course of construction and will reach Weir City by the first of January. The construction work is being rapidly pushed and the material necessary for the building of the road is on the ground. The project is under the supervision of the Pittsburg Light and Power Company, which recently filed a mortgage for $600,000 with the Lincoln Trust Company, of New York, for the purpose of raising funds to carry on the work.

GARDEN CITY, N. Y.—A. T. Stewart's old railroad line, running from Flushing to Garden City, is to be rebuilt by the Long Island Railroad Company and made part of its electrical system. The Stewart railroad was abandoned in 1877, after being operated for about four years. The best part of the road remaining is an old tunnel in Flushing and some car shops on the Flushing meadows. A large force of men is now at work at different points along the old line repairing the embankments and filling them in wherever necessary.

MINNEAPOLIS, MINN.—Sisseton (S. D.) people are planning to organize an electric line to shorten the distance to the twin cities fifty miles. The plan is to connect with the Great Northern at Brown's Valley, Minn., and with the Great Northern and Soo at Hankinson, N. D. Among the promoters of the scheme are H. S. Morris, cashier of the First National Bank; J. A. Rickert, president of the First National Bank; H. L. Spackman, general manager of the Roberts County Land and Loan Company; L. J. Onstad, of the Sisseton Milling Company, and some eastern men.

ROCHESTER, N. Y.—The possibility of building an electric belt line south of Rochester is being considered by Rochester capitalists, among whom are the men who were interested in a proposition to build a line between Rochester, Scottsville, Caledonia and Le Roy. A preliminary survey of the country to be entered may be made this summer. The line would leave the city from South avenue, keeping the east side of the river to East Henrietta. It would then cross the river to Scottsville, go to Caledonia and Le Roy, and return to Rochester through Greigsville, Retsof, Mount Morris, Geneseo, Avon, West Rush, East Rush and East Henrietta, where the loop would be completed.

EDUCATIONAL.

UNIVERSITY OF WISCONSIN—The University of Wisconsin has established a course in chemical engineering, which is offered by the department of chemical engineering of the College of Engineering. Professor Charles F. Burgess, professor of applied chemistry, is in charge of the department. This course is offered to meet the steadily increasing demand for engineering graduates who have, in addition to their engineering training, a good chemical training. Chemical engineers are in demand for such positions as managers, foremen and superintendents of manufacturing concerns employing chemical or metallurgical methods. They are also sought in expert, consulting and constructing work. The course as laid out is intended to train thoroughly the student in the fundamental principles of chemistry and engineering. Specialization along narrow lines is not provided for in the undergraduate work, as it is believed that the technique of industrial work is best acquired after graduation. The course leads to the degree of bachelor of science in four years, or chemical engineer in five years. Considerable option is allowed during the fourth and fifth years, enabling the student to specialize as he may see fit.

PERSONAL MENTION.

MR. ELMER M. WHITE, secretary of the Street Railway Accountants' Association of America, has been appointed assistant secretary and assistant treasurer of the Birmingham (Ala.) Railway Light and Power Company.

MR. B. H. WARREN, who retired from the presidency of the Allis-Chalmers Company on September 1, is named as the head of a new engineering and contracting company which is to be established in New York, and which will be associated with several powerful interests.

MR. W. H. BLOOD, JR., president of the National Electric Light Association, has appointed a committee on standard rules for electrical construction and operation, as follows: Ernest H. Davis, chairman; Captain William Brophy, Louis A. Ferguson, Alex Dow and Samuel Scovill.

MR. C. E. STINSON, manager of construction, operation and maintenance of the Toledo Home Telephone Company, has resigned and returned to his old home in Buffalo, N. Y. It is possible that after a short period of rest Mr. Stinson will take charge of a telephone plant in Rochester, N. Y.

MR. C. F. ANNETT has been appointed superintendent at New Haven, Ct., of the Western Union Telegraph Company. Mr. Annett, who is well known throughout the electrical field, recently returned from Panama where he was in charge of the department of telephones and telegraphs of the canal zone.

MESSRS. DAVID PEPPER, JR., AND ALBERT L. REGISTER announce that the firm of Pepper & Register, engineers and general contractors, Philadelphia, Pa., has been dissolved, and is succeeded by A. L. Register & Company, which firm will conduct the outstanding contracts of the old firm and continue the business.

MR. JOHN J. MOORE, well known in electrical circles, particularly in New England where he was a pioneer electric light man, has accepted the general managership of the United States Light and Heating Company, at 74 Broadway, New York city. This company owns and installs the new Moskowitz system of axle electric train lighting.

MR. PUTNAM A. BATES has succeeded to the business of Bates & Neilson, consulting electrical engineers, New York city. Mr. Bates proposes to continue giving special attention to the preparation of plans, specifications and supervision of electrical installations, investigations and reports, and the application of electric power to machinery.

MR. J. B. PIERCE has been appointed general manager of the Independent Telephone Company, of Syracuse, N. Y. Mr. Pierce is a graduate of Case School of Applied Science, and succeeds Mr. F. M. Potter, Jr., who has become vice-president and chief engineer of the Wire and Telephone Company of America, at Rome, N. Y. Mr. Potter was presented with a gold watch and fob by his associates in the telephone company.

MR. EDWARD R. KNOWLES, E. E., C. E., New York city, N. Y., has been appointed by the Brooklyn Masonic Guild as its consulting engineer for the light and power installations to be made in the new Masonic Temple, about to be erected in the borough of Brooklyn. Mr. Knowles is a thirty-third-degree Mason and is well known as an expert in this line of work and will undoubtedly make this installation complete and up to date.

MR. WILLIAM RANDOLPH STRICKLAND has resigned from the New York Central Railroad, and is now associated with J. G. White & Company, New York, as assistant to the secretary. Mr. Strickland is a graduate of the Massachusetts Institute of Technology, and during the Spanish War served at the Mare Island navy yard as assistant engineer. While on the U. S. S. Bennington as assistant engineer he had charge of the operation, maintenance and repair of all the machinery about the ship. After the war Mr. Strickland was employed by the Blake Pump Company and Buckeye Engine Company as draughtsman, and also in designing special electric cranes and controllers for the Case Manufacturing Company in the capacity of assistant and also as chief engineer. Mr. Strickland made the hydraulic calculations for the North Fork power-house scheme at Denver, Col., in 1900. After he had completed this work he joined the staff of the Colorado Fuel and Iron Company as engineer of location on a standard-gauge line over M'Clure pass. He also located several electrical and steam narrow-gauge lines in Colorado. In 1902 Mr. Strickland was appointed designing engineer for the Lannius Machine Company and in that capacity laid out its combined amalgamator, concentrator and arrester. In 1903 he was appointed location engineer on the New York Central Railroad and supervised the extension from Cherry Tree to Possum Glory as well as several of its double-tracking and grade-revision schemes. For the past year Mr. Strickland has been assistant engineer in the maintenance of way department, handling correspondence from all divisions in regard to the repair and construction of bridges and buildings.

ELECTRICAL SECURITIES.

Notwithstanding the sharp break following the peaceful development of the conference between the envoys of Japan and Russia, the vital underlying conditions in industrial, agricultural and financial quarters are strong and healthy and endowed with every prospect of continuing in this wise. With the approach of colder weather the outlook for a bumper harvest is better than ever, and even now it is stated that the inland banks are full of the farmers' money. This is one of the best signs, for the agriculturist is a good spender and can always be counted upon to set the ball rolling to gather up good investments and mark out a path for development and improvement.

ELECTRICAL SECURITIES FOR THE WEEK ENDING SEPTEMBER 2.

New York:	*Closing.*
Brooklyn Rapid Transit	68⅜
Consolidated Gas	184¾
General Electric	180
Interborough Rapid Transit	217
Kings County Electric	200
Manhattan Elevated	164
Metropolitan Street Railway	128⅝
New York & New Jersey Telephone	168
Westinghouse Manufacturing Company	180

The quarterly rental of 1¾ per cent on Metropolitan Street Railway stock will be paid on October 15.

Boston:	*Closing.*
American Telephone and Telegraph	140¾
Edison Electric Illuminating	252
Massachusetts Electric	60
New England Telephone	134
Western Telephone and Telegraph preferred	97½

Philadelphia:	*Closing.*
Electric Company of America	11½
Electric Storage Battery common	84¾
Electric Storage Battery preferred	84¾
Philadelphia Electric	8¾
Philadelphia Rapid Transit	28¼
United Gas Improvement	97¾

Gross earnings of the Philadelphia Rapid Transit Company for the month of August are expected to show an increase over the same month last year of about $50,000. It is reported that the present season at Willow Grove has been the best since the park originally opened.

Chicago:	*Closing.*
Chicago Telephone	133
Chicago Edison Light	157
Metropolitan Elevated preferred	67½
National Carbon common	62
National Carbon preferred	115
Union Traction common	8
Union Traction preferred	33

The daily average of traffic of Northwestern Elevated for the month of August was 68,938, an increase of 6,485.

Directors of the South Side Elevated Railroad, of Chicago, have declared the regular quarterly dividend of 1 per cent, payable September 30 to stockholders of record September 20.

It is said that Metropolitan Elevated will show a reserve of $675,000 at the end of the half year, September 1, comparing with $465,000 March 1, and $10,000 on March 1 two years ago A dividend recommencement of 3 to 4 per cent annually on the preferred is considered certain this fall or early in 1906. The road showed a heavy traffic gain during August.

NEW INCORPORATIONS.

DES MOINES, IOWA—Anamosa Electric Light and Power Company. $35,000.

LANSING, MICH.—Michigan Railway and Light Company, Owasso. $10,000.

ALBANY, N. Y.—Southold Lighting Company, Southold, L. I. Increased to $7,000.

SAN FRANCISCO, CAL.—The California Electric Light Company, San Francisco. Reduced from $5,000,000 to $500.

TEDDY, OKLA.—Caddo Telephone Company. $5,000. Directors: George H. Studebaker, Ora P. Studebaker, Louis H. Fahring.

SPRINGFIELD, ILL.—Effingham County Telephone Company. $6,000. Incorporators: S. E. Munday, A. B. Munday and G. F. Taylor.

MADISON, WIS.—The Phillips Light, Power, Heat and Water Company. $25,000. Incorporators: John R. Davis, Ellen Davis and P. Davis.

PORTLAND, ME.—Citizens' Water and Light Company. $230,000. Officers: president, C. E. Glauflin, Portland; treasurer, H. L. Cram, Portland.

BOSTON, MASS.—Southbridge Gas and Electric Company, Southbridge. $50,000. Officers: president, H. C. Cady; treasurer, George W. Corey.

AUSTIN, TEX.—Coast Telephone Company, El Campo, Wharton County. $5,000. Incorporators: T. J. Poole, C. W. Robinson, E. H. Koch and F. J. Hardy.

ALBANY, N. Y.—Westfield Street Railway, Westfield, Chautauqua County. $40,000. Directors: G. J. Sontag, R. S. Storrs and J. J. Smith, New York.

MADISON, WIS.—The Lafayette Telephone Company, of Gratiot, Lafayette County. $25,000. Incorporators: H. W. Burmeister, S. Birkbeck and Edward Brannan.

RICHMOND, VA.—Norfolk County Railroad Company, Norfolk. $5,000. Incorporators: A. B. Seldner, president; A. P. Warrington, secretary and treasurer, both of Norfolk.

CLARENCE, N. Y.—The Pioneer Telephone Company. $10,000. Directors: C. D. Carmer, O. A. Martin, William Bald, E. Weinanger, H. G. Britting, F. C. Goold and F. W. Schaad.

PLAINVILLE, N. Y.—Plainville Telephone Company. $2,000. Directors: William B. Cox, M. S. Wilson, Enos Smith, Ervin A. Cummins, Frank J. Smith, Charles F. Davis and Lisle J. Schenck.

NORTH WILKESBORO, N. C.—Gordon Manufacturing and Power Company. To operate an electric plant. $21,000. Incorporators: J. Gordon Hackett, Richard N. Hackett, H. W. Gwyn.

CAMDEN, N. J.—Juniata Hydroelectric Company. To build and construct light, heat and power plants. $100,000. Incorporators: William Innes Forbes, S. L. Brumbaugh, George H. B. Martin.

RICHMOND, VA.—Princess Anne & Virginia Beach Telephone Company, Virginia Beach. $5,000. Incorporators: J. Woodhouse, president; H. C. Woodhouse, treasurer; John S. Woodhouse, secretary, all of Norfolk.

LANSING, MICH.—Menominee & Escanaba Railway Company. $300,000. Stockholders: William Holmes, of Menominee; W. A. Holmes, of Crystal Falls; Guy W. Holmes, of Marinette, and Willis N. Mills, of Menominee.

ALBANY, N. Y.—The Suffolk County Lighting Company. To manufacture gas and electricity for lighting in the villages of Suffolk and Nassau counties. $50,000. Directors: George MacDonald, C. A. Hickey and W. H. Morgan, of New York city.

CHARLESTON, W. VA.—The Blankenship Manufacturing Company, of Moundsville. For producing and selling electricity for light, heat and power, and maintaining and conducting lines for the distribution thereof. $50,000. Incorporators: R. G. Blankenship, B. M. Burtry, Hiram Keller and J. D. Spurr, of Moundsville, and A. E. Holderman, of Pittsburg.

TELEPHONE AND TELEGRAPH.

BIRMINGHAM, ALA.—The Southern Bell Telephone Company is arranging to extend its lines into West Jasper.

MILANO, TEX.—A company of Hanover and Milano citizens has organized what is known as the H. R. F. Telephone Company, and is constructing a line from Milano to Hanover.

LOS ANGELES, CAL.—Between $50,000 and $60,000 will be spent in the installation of a complete telephone system for Ensenada. The work is under the direction of J. D. Cameron, of Los Angeles.

MIDDLETOWN, N. Y.—The Hudson River Telephone Company has started work on a new telephone line to Port Jervis. There will be eight copper wires. The line goes by way of Slate Hill, South Centreville and Greenville.

PULASKI, N. Y.—Another farmers' line, extending from the Pulaski exchange of the Empire State Telephone and Telegraph Company to the Centreville district, has been completed. Another line will extend from the local exchange to the Lehigh district, four miles southeast of Pulaski. Fernwood will also have a line extending from the Pulaski exchange.

UTICA, N. Y.—The Independent Telephone Securities Company at a recent meeting elected George R. Fuller, of Rochester, vice-president and general manager. The general offices of the company will be transferred from Utica to Rochester. Mr. Fuller is president of the Rochester exchange, which recently purchased the controlling stock of the Securities Company.

PALOUSE, WASH.—Six rural telephone lines, leading into Palouse, have formed an independent telephone system, with both local and long-distance connections. The following lines are in the system: Turnbow, Parker, Garfield, Cove, Ickes and Boone rural lines. Through this central office the farming community will be enabled to talk with Palouse, Moscow, Colfax, Pullman, Garfield and Princeton.

MINNEAPOLIS, MINN.—Browerville Telephone Company, Browerville; $10,000; incorporators: Thomas Held, H. F. Hart, J. H. Streets, J. F. Sarff, Harry Lee, Lambert Irsfeld and W. H. Gray. Browerville, Philbrook & Motley Telephone Company, Browerville; $99; incorporators: Chester Hawley, C. A. Jones, Harry Lee, John H. Sheets, T. Tyrell, Browerville; C. K. Randall and William Roberts, Philbrook.

FRANKFORT, IND.—The council of the city of Frankfort has granted a franchise to the New Long-Distance Telephone Company, giving it the right to construct, maintain and operate a toll telephone system out of the city of Frankfort, for a period of twenty-five years. The franchise does not include a local telephone system, however, it being especially stipulated in the franchise that a local service should not be operated by the New Long-Distance Telephone Company.

PHILADELPHIA, PA.—Work on improvements and extensions provided for by the recent sale of $4,000,000 bonds by the Keystone Telephone Company is going on rapidly. Sixty thousand feet of duct have been put in, and new cables are being laid in many parts of the city. The western half of the territory covered by the Park exchange will be completed, it is expected, by September 15. As soon as the cables are laid the installing of telephones will begin. In the down-town district the present cables are crowded and new ones must be laid before any increase in the number of telephones is made. It will be probably two months before the installation of telephones is commenced.

CONNELLSVILLE, PA.—The announcement of a sweeping change in rates is made by R. N. Litton, of Pittsburg, division superintendent of the Bell telephone system. Beginning September 1 the business party lines will be abandoned and the telephone rate for business houses will be $24 instead of $42. For private house telephones the rate will be reduced from $33 to $18. The additional charge for desk telephones will be reduced from $6 to $3 and for auxiliary extension desk telephones from $12 to $6. Subscribers in Connellsville, Uniontown, Brownsville, Dawson, Dunbar, Fairchance, McClellandtown and Masontown will be permitted to talk to each other free of toll charge, to the amount of their monthly rental.

ELECTRIC LIGHTING.

CAPE VINCENT, N. Y.—Theresa has voted by forty-one majority to expend $20,000 for an electric light plant.

NEW HARTFORD, N. Y.—A public meeting will be held on September 26 to consider the matter of lighting upper New York Mills electrically.

BOLIVAR, TENN.—The committee to let contracts for material for the water and electric light plant has awarded the same to Memphis, Jackson, St. Louis and Chicago firms.

ALBANY, N. Y.—The state commission on gas and electricity has granted the new light, heat and power company of Newark, N. Y., permission to issue $75,000 first mortgage bonds.

GREENWOOD, WIS.—By a vote of more than two to one, Greenwood decided in favor of issuing bonds to the sum of $15,000 for an electric light system. Black river is to be dammed and furnish several hundred horse-power.

ST. PAUL, MINN.—The electric light company has been directed to provide twenty additional street lights, eight in the first ward, five in the second and seven in the third. They are to be put up at once under the direction of aldermen.

AUDUBON, N. J.—The city of Audubon has entered into a five-year lighting contract with the Public Service Corporation. The contract calls for sixteen-candle-power lamps, at $15 a year for two years; and twenty-five-candle-power at $20 a year for three years.

MONROE, MICH.—Council has set Monday, September 11, as the date for a special election to vote on selling the city electric plant to the General Construction Company, of Detroit, for $25,000 cash; also to vote on the ratification of such a contract.

MEAFORD, ONT.—The ratepayers of the town of Meaford have voted to expend $7,500 for the purchase of an electric light plant and to pay W. Moore & Sons $4,400 per year for supplying electric power to operate the same in connection with the waterworks.

BIRMINGHAM, ALA.—A number of extensions are being contemplated by the Jasper Water, Light and Power Company, by which portions of the city heretofore not reached are to have water and light. The electric line is to be extended west in the West Jasper district.

SACRAMENTO, CAL.—The California Electric Light Company has filed with the secretary of state a certificate of diminution of capital to $500 in 50,000 shares of the par value of one cent each. The company filed articles of incorporation on June 30, 1879, with a capital of $5,000,000.

BUFFALO, N. Y.—In a few months the Ontario Power Company will deliver power at the steel plant in West Seneca. Temporary wires have been stretched across the Niagara gorge and permanent wires will soon be in position. Lockport will get power in thirty days, West Seneca in a month or two, and Syracuse by February, 1906.

BRISTOL, TENN.—It is stated that the Bristol Gas and Electric Company will expend more than $100,000 for the improvement and enlargement of its plant, the new machinery to include steam turbines of the latest design. The General Electric Company, of Schenectady, N. Y., is understood to have recently bought control of the Bristol company.

FORT GAINES, GA.—J. J. Sellman, civil engineer, of New York city, representing the Interstate Water Works and Construction Company, of Washington, D. C., has been making surveys, plans and specifications for the construction of a complete system of water works and electric lighting plant. The franchise was granted a few weeks ago, and the work of construction will commence at once.

JACKSON, MISS.—The stockholders of the Jackson Light and Power Company have voted an increase in their capital stock of $10,000 for the purpose of buying new machinery. This is a home company and independent of the Jackson Electric Railway and Power Company. The enlargement of the plant is made necessary by the increase in business. The machinery has been ordered and will be installed this fall.

CRESTON, IOWA—The contract has been awarded for the erection of the new power-house for the recently organized electric light, heat and power company of Creston. The bid accepted by the committee was for $8,500. According to the plans and specifications, the new building will be constructed of pressed brick and the roof will be tile. The size of the building will be 74 by 110 feet. Work will be commenced as early as possible.

STAMFORD, CT.—At the annual meeting of the stockholders of the Stamford Gas and Electric Company it was voted to sell the 820 shares of stock in the company's treasury. This stock was reserved for making additions to the company's plant, and when its sale is consummated the full amount of capital stock the company is authorized to issue will have been paid in. The old board of directors was reelected.

PERTH AMBOY, N. J.—The Perth Amboy city council has granted a franchise to the Citizens' Electric Light, Heat and Power Company, which will pay to the city two per cent of its gross receipts after eight years. The franchise is for twenty-one years. The light company is to use conduits after five years, placing not less than 5,000 feet of wire underground during each five years, until all wire is in conduits.

BRATTLEBORO, VT.—The city has entered into a contract for lighting with the Brattleboro Gas Light Company. By the terms of the new contract all-night arcs will cost $90, midnight arcs $75, and incandescent lights $17, and they will burn every night in the year. The reduction in price and the additional service is equivalent to over $1,000 a year. The village has thirty-one 2,000-candle-power lamps, seven 1,200-candle-power lamps and eighty-eight incandescent lamps of twenty-five candle-power.

SALT LAKE CITY, UTAH—J. H. Bigger and J. E. Hill, of Salt Lake City, expect to develop 950 horse-power for electric lighting and for propelling machinery in the American Fork mining district, according to an application filed in the office of the state engineer. The application asks for twenty-two feet of water, to be taken from American Fork creek. The proposed diverting works are to consist of a dam, spillway, headgate and pipe line, the last-named to be about 4,000 feet in length and three feet in diameter. It is understood the application is made in the interest of a plant for the Pittsburg mine.

BRIDGEPORT, CT.—The New Milford Water Power Company has been annexed by the Connecticut Railway and Lighting Company. The New Milford company had a thirty-year contract to furnish power to the Connecticut Railway and Lighting Company at $130,000 a year. At the last session of the General Assembly, the New Milford company was authorized to issue bonds to the amount of $2,000,000, of which $1,000,000 was to be applied to refund existing bonds. The plant of the company is located at Bull's Bridge, on the Housatonic river in Litchfield County. The power is transmitted to a maximum distance of forty-five miles for the operation of trolley cars and for lighting purposes. It goes into Waterbury and Cheshire and as far as New Britain.

WARREN, PA.—Sealed proposals will be received up to twelve o'clock M., September 15, 1905, for completion of electric lighting system at the state hospital for the insane at Warren, Pa., including one 100-horse-power engine, one sixty-two and one-half-kilowatt, three-wire, two-voltage generator, generator panel, wiring and lighting grounds and outside buildings, also building line from present dynamo room in main hospital building to Farm Colony building and wiring same; also for furnishing gas engine, generator, switchboard and wiring building at Farm Colony. Plans and specifications are on file at the state hospital, Warren, Pa., at office of W. E. Parker, electrical engineer, Ellicott square, Buffalo, N. Y., and at Builders' Exchange, Erie, Pa.

NEW MANUFACTURING COMPANIES.

MADISON, WIS.—The International Electric and Manufacturing Company, with a capital of $300,000, has been incorporated by William Ross, E. H. Roller and F. F. Dittmar.

ATLANTA, GA.—Articles of incorporation have been filed for the Southern States Electric Company. The petitioners for charter are J. W. Little, Charles M. Coyen and E. Gillespie. They will conduct a general electrical business with a capital stock of $20,000. The principal office and place of business will be located in Fulton County, the right being asked to establish offices and transact business in other places within and without the state.

INDUSTRIAL ITEMS.

QUEEN & COMPANY, INCORPORATED, 1010 Chestnut street, Philadelphia, Pa., in circular No. 605 describes new testing instruments for measuring resistance.

THE GARVIN MACHINE COMPANY, Spring and Varick streets, New York city, will be pleased to send a new bulletin descriptive of direct constant-feed milling machines.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., in bulletin No. 144 publishes an article by A. W. Henshaw entitled "Electric Power in Factories."

THE CORRUGATED CONCRETE PILE COMPANY, 34 West Twenty-sixth street, New York city, has published an attractive booklet calling attention to the use of corrugated concrete pile for construction work.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., in the September issue of "Graphite" publishes a number of interesting articles concerning the use of graphite for a multitude of purposes. There is a fine reproduction of the Trinity Building, New York city, and also of the state bridge at Danville, Pa.

THE BRYANT ELECTRIC COMPANY, Bridgeport, Ct., is distributing an attractive and useful calendar, running from September, 1905, to December, 1906. A view in colors of the factories of the Bryant Electric Company and the Perkins Electric Switch Manufacturing Company at Bridgeport illuminates the calendar hanger.

STANLEY & PATTERSON, INCORPORATED, 40 Cortlandt street, New York city, is again calling attention to the "Faraday" skeleton bell. In this instance a large blue mailing-card states the characteristics of the gong of the "Faraday" skeleton bell. The design and construction of the gong is concisely explained. Full information can be secured from the company.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago, Ill., is getting out a new catalogue very much larger than the last one issued, which will be ready for distribution by October 1. The company is producing a number of new devices, and this catalogue will contain considerable additional matter. Several improvements have also been made in the "Arc-Burst" cluster manufactured by the company, and these will be elaborately illustrated in the new catalogue.

THE NILES-BEMENT-POND COMPANY, 111 Broadway, New York city, has issued a handsome catalogue descriptive of Niles electric traveling hoists and trolleys. These trolleys and hoists run on a single I-beam, making it possible to install them in places where it would be impossible to arrange for crane runways. In addition to complete descriptive matter, photographs of the electric traveling trolley and plans and elevations of installations are given.

J. G. WHITE & COMPANY, New York city, will be represented at the convention of the American Street Railway Association, to be held in Philadelphia, September 25 to 30, by Mr. W. E. Harrington, operating manager of the operating department; Mr. W. E. Goldsborough, business manager of the engineering department, and Mr. William Pestell, assistant mechanical engineer in charge of matters relating to rolling stock and equipment of the street railway and engineering departments of the company.

THE NATIONAL BATTERY COMPANY, Buffalo, N. Y., is calling attention to the "National Sparkers." This sparker is the result of expert study of the requirements of gasoline ignition, and the company announces that 10,000 of these sparkers were sold in the United States in the past year. A bulletin has recently been issued by the National Battery Company describing the use of electric storage batteries for line voltage regulation on a water-power system. This is an installation of "Unit Accumulators" for the Syracuse & Suburban Railroad Company, of Syracuse, N. Y.

THE ROBINS CONVEYING BELT COMPANY, Park Row Building, New York city, has issued bulletin No. 12 descriptive of hoisting and conveying machinery for power stations. This describes the belt-conveying system installed by the Robins company. The frontispiece is a view of the works of the Robins Conveying Belt Company at Passaic, N. J. In addition to the descriptive matter sectional and perspective views are given of the belt, the idlers, pillow blocks, distributing trippers and other details. Several views are shown, giving an idea of a typical conveying-belt installation.

THE ELECTRIC MOTOR AND EQUIPMENT COMPANY, Newark, N. J., has secured a contract from the Hotel Astor, New York city, for two Heiny electric carriage calls, a new device which has recently been placed upon the market. The Electric Motor and Equipment Company has recently succeeded to the business of the Mason Monogram Company, manufacturer of a talking sign. Contracts have been secured for furnishing these signs to the following companies: James Durkin, Spokane, Wash.; Wilkesbarre Gas and Electric Company, Wilkesbarre, Pa.; Haverhill Electric Light Company, Haverhill, Mass.; McKay Engineering Company, Baltimore, Md.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has published a series of handsome catalogues descriptive and illustrative of several of its products. Bulletin No. 1600 describes and illustrates a test and record of a 30,000,000-gallon pumping engine installed in the Chestnut Hill high-service station of the Metropolitan waterworks, Boston, Mass. Bulletin No. 1601 describes and illustrates a test of one of the 15,000,000-gallon vertical triple-expansion pumping engines installed in the Baden high-service station of the St. Louis (Mo.) waterworks. Catalogue No. 126 describes and illustrates hoisting engines and accessories, and catalogue No. 122 smelting furnaces and accessory equipment.

THE AMERICAN METAL STAMPING COMPANY, INCORPORATED, Germantown, Philadelphia, Pa., has issued bulletin A, series 1, 1905, which is designated as an architects' edition, and describes light balancing selective diffuser ceilings. A great many photographic reproductions of this latest development for store and other interior lighting are given, as well as sectional views of the woodenwork and wiring construction diagrams. The arc lamps used in connection with the diffuser ceilings embody all the latest improvements, both electrical and mechanical, and represents the advanced development of the General Electric Company, Schenectady, N. Y. A remarkable series of night views of the illuminating features of several large department stores is given, and in addition to this there is a very interesting and instructive article by W. D'A. Ryan on "Color and Distribution of Artificial Lights."

NEW PUBLICATIONS.

TRANSACTIONS OF THE AMERICAN ELECTROCHEMICAL SOCIETY—The seventh volume of the transactions of the American Electrochemical Society, containing papers and discussions of the meeting held in Boston and Cambridge, Mass., last April, is being distributed. This volume contains a number of valuable contributions and some particularly interesting discussions of electrochemical and electrometallurgical matters. The price to nonmembers is $3.

A DIGEST OF UNITED STATES PATENTS OF AIR, CALORIC, GAS AND OIL ENGINES—James T. Allen, United States patent office examiner, has compiled a digest of United States patents of air, caloric, gas and oil engines from 1789 to July, 1905. The published volume will contain from 1,000 to 2,000 pages, and the work will be chronologically arranged under 205 subdivisions in three volumes. There will be given the drawings, claims and briefs, list of references cited by number, name and date, the interferences, the parties thereto, and the decisions while the applications (now patents) were being examined in the United States patent office.

THE WESTERN ELECTRICAL DIRECTORY—The first issue of the *Western Electrical Directory* has been published by the Blanchfield Publishing Company, Rialto Building, San Francisco, Cal. In this directory the publisher has endeavored to note the names of all electrical companies operating in the western states, the territory of Hawaii, British Columbia, Yukon territory, Alaska, and a portion of Mexico. The names of electrical companies which have been absorbed, succeeded or discontinued during the past ten years are also given. The members of the Pacific Coast Electrical Transmission Association, the western members of the American Institute of Electrical Engineers and the members of the Colorado Electric Light, Power and Railway Association are listed.